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XII

TRANSCRIPT OF RECORD

Government Exhibits

VOLUME XII

IN THE

DISTRICT COURT OF THE UNITED STATES

For the District of New Jersey

United States of America

vs.

United States Steel Corporation and others

HD
2780
S85
U5
v.42

A.297853

GOVERNMENT EXHIBITS,

VOLUME XII.

INDEX.

Government Exhibit	Subject.	Page.
No. 364.	Pamphlet showing the Production of Iron Ore, Pig Iron, and Steel in 1911	2569
No. 365.	Pamphlet showing the Production of Iron Ore, Pig Iron, and Steel in 1909	2625
No. 369.	Pamphlet entitled "Statistics of the American Iron Trade for 1904"	2655

Government Exhibits 364, 365 & 369.

NOTE.

Portions of the three following exhibits, Nos. 364, 365 and 369, were introduced in evidence at pages 3366 and 3369 (Volume VIII) of the printed record. The entire pamphlets were not offered in evidence until page 3736 of the record, making it necessary to print them at this point out of their regular numerical order.

Government Exhibit No. 364

IRON ORE, PIG IRON, AND STEEL.

By Ernest F. Burchard.

INTRODUCTION.

Among the most noteworthy features of the iron mining and manufacturing industries in the United States in 1911 was the decided decrease in production of iron ore, pig iron, and steel compared with the production in 1910. This decrease was due primarily to the fact that there was a large overproduction in 1910, and secondarily to a lessening in demand in 1911. Buying on the part of railroads and for new equipment of manufacturing plants was curtailed. Prices did not reach the lowest levels and thus afforded no incentive to stimulate buying. These conditions were foreshadowed in the last four months of 1910 and lasted well into the second half of 1911, but in the closing months of the year recovery was rapid and at the end of the year there was a decidedly more hopeful tone.

Other features of the year's progress were the initial shipments of iron ore from the Cuyuna range, in Minnesota, on which prospecting has been in progress for about nine years and development work has been done during the last two or three years. Active exploratory work has been carried on in the Marquette and Menominee ranges, and several new deposits have been blocked out. The Michigan State board of tax commissioners appraised the value of the iron mining properties of the State, using as a basis an estimate of the iron ore reserves of Michigan made by C. K. Leith, a summary of which is published elsewhere in Mineral Resources for 1911.

A strong movement for the conservation of iron ore by beneficiation (washing, concentrating, roasting, nodulizing, and briquetting) is under way in the Lake Superior region. The plants for dressing iron ore, including works recently built and in operation and those now under construction, are the following:[1]

Sand washeries for the Oliver Iron Mining Co. and the International Harvester Co., at Coleraine and Nashwauk, Mesabi range.

Drying plants for the Hollister and Brunt mines, of the Crystal Falls district, and at Mountain Iron, Mesabi range.

Crushers for hard ores, at Biwabik, Escanaba, and elsewhere.

Roasting works for the Magpie and Atikokan mines, at Magpie, Michipicoten range, and at Port Arthur, Ontario.

Pyrite washery for the Helen mine, Michipicoten range.

Magnetic concentrator and briquetting work for the Moose Mountain mines, at Sellwood, Ontario.

Nodulizing plant for the Kloman mine, at Republic, Marquette range.

Sizing and briquetting plant at the Northwestern Iron Co. mine, Mayville, Wis.

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[1] Woodbridge, D. E., Lake Superior ore developments in 1911: Iron Age, Jan. 4, 1912, p. 67.

The curve showing pig-iron production by months (fig. 3) affords a graphic index of the trend of the pig-iron industry from the beginning to the end of the year and also a comparison of the conditions in 1911 with those during the preceding four years. The monthly course of pig-iron production in 1911 was rather broken, with two peaks, one in March, the other in October, but the total variation approximated only about 400,000 tons, and the mean course ran slightly less than 1,950,000 tons a month. The year closed with a rising production, the daily production for December, 1911, averaging about 66,000 tons, as compared with 57,000 tons in December, 1910. On December 31, 1911, there were 231 furnaces in blast out of a total of 466; on the same date in 1910 there were 206 furnaces in blast out of a total of 473. The iron-ore output declined from that of 1910 by 13,339,101 long tons. The total quantity of iron ore marketed in 1911 for the purpose of making pig iron—that is, not including stocks left at mines nor iron ore used for fluxing other metallic ores nor in the manufacture of paints—was 40,989,808 long tons, as compared with 53,616,670 tons, in 1910 and with 51,155,437 tons in 1909; the output of pig iron, including ferroalloys, in 1911 was 23,649,547 long tons, as compared with 27,303,567 tons in 1910 and with 25,795,471 tons in 1909.

The ore reported as having been used for fluxing other metallic ores during 1911 amounted to 102,639 long tons, valued at $296,745, as compared with 125,172 long tons in 1910, valued at $446,996. The quantity of iron ore sold by the miners for paint during 1911 was reported as 10,251 long tons, valued at $31,092. Prices of pig iron, which steadily declined during 1910, rose slightly during the first four months of 1911, but later sagged slowly until the end of the year and closed at 50 to 75 cents lower than at the end of 1910.

The decrease in the production of iron ore in 1911 from that of 1910 was 23.4 per cent, and the decrease in the production of pig iron and steel was 13.38 per cent and 9.28 per cent, respectively.

IRON-ORE INDUSTRY OF THE UNITED STATES.

OUTPUT OF IRON ORE BY GEOGRAPHIC DISTRICTS.

The iron ore marketed in the United States in 1911 amounted to 40,989,808 long tons, valued at $86,419,830 at the mines. The iron ore mined in 1911 was 43,550,633 long tons, valued at $91,891,836, as compared with 56,889,734 long tons, valued at $140,735,607, mined in 1910. This represents a decrease of 23.4 per cent in tonnage and of 34.7 per cent in value. The average price per ton for the whole country in 1911 was $2.11, as compared with $2.47 in 1910. By the term "ore marketed" is meant the quantity of ore sold or used by the producer for the manufacture of pig iron, and practically coincides with the term "shipments" used by trade papers. The reason for not using the term "shipments" in collecting the iron ore statistics is that ore producers, especially those in the South who consume a large part of their production in their own furnaces adjacent to the mines, may differentiate their ore consumption from their shipments to distant points.

Iron ore was mined in 27 States during 1911. Of these, four States—Idaho, Montana, Nevada, and Utah—produced ores for fluxing only; part of Colorado's production was for fluxing and part for pig iron; Michigan produced a very small quantity for flux, and a small quantity was produced in Missouri for special fluxing use; the remaining States produced ores for blast-furnace use.

The States in which iron ore occurs may be conveniently grouped into six geographic districts, namely:

1. *Northeastern district.*—Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, and Ohio.

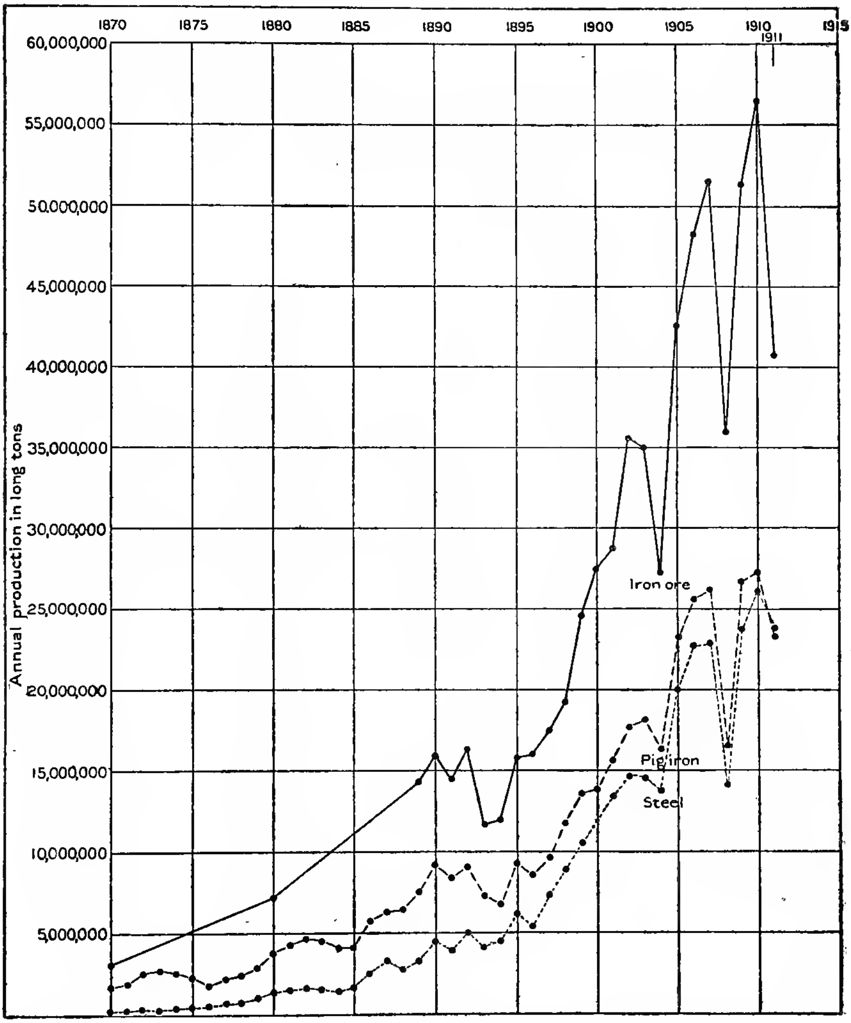

FIGURE 2.—Curve showing the production of iron ore, pig iron, and steel in the United States, 1870 to 1911.

2. *Southeastern district.*—Maryland, the Virginias, Kentucky, Tennessee, North Carolina, Georgia, and Alabama.

3. *Lake Superior district.*—Michigan, Wisconsin, and Minnesota.

4. *Mississippi Valley district.*—Iowa, Mississippi, Missouri, Arkansas, and Texas.

5. *Rocky Mountain district.*—Idaho, Montana, Wyoming, Colorado, New Mexico, Utah, and Nevada.

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6. *Pacific slope district.*—Washington and California.

Each of these districts may be subdivided into mining districts and the ores classified with regard to variety and to distribution of deposits. These subdivisions are discussed in another section. The Lake Superior is by far the most important of these districts, and is followed in order by the southeastern district and the northeastern district; the Mississippi Valley and the western districts are of minor importance. The following table shows the relative output of iron ore in each of these geographic districts during 1909, 1910, and 1911:

Production of iron ore in the United States, by geographic districts, in 1909, 1910, and 1911, in long tons.

District.	1909		1910		1911 [a]	
	Quantity.	Percentage of total.	Quantity.	Percentage of total.	Quantity.	Percentage of total.
Northeastern	2,280,741	4.46	2,605,318	4.58	1,966,348	4.80
Southeastern	6,197,717	12.11	6,894,464	12.12	5,407,821	13.19
Lake Superior	41,942,969	81.99	46,420,226	81.60	32,902,562	80.27
Mississippi Valley	96,428	.19	107,876	.19	73,388	.18
Rocky Mountain	637,582	1.25	861,850	1.51	639,689	1.56
Pacific slope	(b)	....	(b)	....	(b)	....
Total	51,155,437	100.00	56,889,734	100.00	40,989,808	100.00

[a] Figures for 1911 represent marketed production.
[b] Pacific slope included in Rocky Mountain district.

PRODUCTION OF IRON ORE BY STATES.

The following table gives a comparison of the iron-ore production, by States, for 1910 and 1911, showing increase and decrease and the percentage of increase and decrease in the several States, the figures for 1911 representing marketed production:

Quantity and value of iron ore produced in the United States, 1910 and 1911, by States.

State.	1910		1911		Increase (+) or decrease (−) in 1911.		Percentage of increase (+) or decrease (−) in 1911.	
	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.	Quantity.	Value.
Alabama	4,801,275	$6,083,722	3,955,582	$4,876,106	− 845,693	−$1,207,616	− 17.61	− 19.85
Georgia	313,878	482,659	207,279	315,704	− 106,599	− 166,955	− 33.96	− 34.59
Kentucky and West Virginia	64,347	86,085	71,979	92,575	+ 7,632	+ 6,490	+ 11.86	+ 7.54
Maryland and North Carolina	79,340	143,342	92,382	161,929	+ 13,042	+ 18,587	+ 16.44	+ 12.97
Michigan	13,303,906	41,393,585	8,944,393	23,808,935	−4,359,513	−17,584,650	− 32.77	− 42.48
Minnesota	31,966,769	78,462,560	23,398,406	48,447,760	−8,568,363	−30,014,800	− 26.80	− 38.25
Missouri	78,341	168,697	72,788	153,676	− 5,553	− 15,021	− 7.09	− 8.90
New Jersey	521,832	1,582,213	359,721	1,158,271	− 162,111	− 423,942	− 31.07	− 26.79
New York	1,287,209	3,848,683	1,057,984	2,959,009	− 229,225	− 889,674	− 17.81	− 23.12
Ohio	22,320	35,866	16,697	30,549	− 5,623	− 5,317	− 25.19	− 14.82
Pennsylvania	739,799	911,847	514,929	539,553	− 224,870	− 372,294	− 30.40	− 40.83
Tennessee	732,247	1,048,323	469,728	632,339	− 262,519	− 415,984	− 35.85	− 39.68
Texas	29,535	34,003	....	....	− 29,535	− 34,003	−100.00	−100.00
Virginia	903,377	1,845,144	610,871	1,146,188	− 292,506	− 698,856	− 32.38	− 37.88
Wisconsin	1,149,551	3,610,349	559,763	1,386,616	− 589,788	− 2,223,733	− 51.30	− 61.59
Other States [a]	896,008	998,529	657,306	710,620	− 238,702	− 287,909	− 26.64	− 28.83
Total	56,889,734	140,735,607	40,989,808	86,419,830	−15,899,926	−54,315,677	− 27.95	− 38.59

[a] 1910: California, Colorado, Connecticut, Massachusetts, New Mexico, Washington, and Wyoming; 1911: California, Colorado, Connecticut, Massachusetts, Mississippi, New Mexico, and Wyoming.

The columns showing percentage of increase or decrease bring out the interesting fact that with the exception of the groups Kentucky-West Virginia and Maryland-North Carolina every other State showed a decrease in both production and value, and that with the exception of New Jersey and Ohio in every producing State in which a decrease occurred the percentage of decrease in value was considerably greater than the percentage of decrease in quantity of ore marketed.

In the following table the States are arranged according to their rank in 1910 and 1911 with regard to both the quantity and the value of the iron ore marketed:

Rank of iron-ore producing States in 1910 and 1911, with quantity and value of product and percentage of each.

1910.

Rank.	State.	Production.		Rank.	State.	Value.	
		Quantity, in long tons.	Percentage of total production.			Amount.	Percentage of total value.
1	Minnesota	31,966,769	56.19	1	Minnesota	$78,462,560	55.75
2	Michigan	13,303,906	23.39	2	Michigan	41,393,585	29.41
3	Alabama	4,801,275	8.44	3	Alabama	6,083,722	4.32
4	New York	1,287,209	2.26	4	New York	3,848,683	2.74
5	Wisconsin	1,149,551	2.02	5	Wisconsin	3,610,349	2.57
6	Virginia	903,377	1.59	6	Virginia	1,845,144	1.31
7	California, Colorado, New Mexico, Washington, and Wyoming	861,850	1.52	7	New Jersey	1,582,213	1.12
8	Pennsylvania	739,799	1.30	8	Tennessee	1,048,323	.75
9	Tennessee	732,247	1.29	9	Pennsylvania	911,847	.65
10	New Jersey	521,832	.92	10	California, Colorado, New Mexico, Washington, and Wyoming	877,223	.62
11	Georgia	313,878	.55	11	Georgia	482,659	.34
12	Missouri	78,341	.14	12	Missouri	168,697	.12
13	North Carolina	65,278	.11	13	Connecticut and Massachusetts	121,306	.09
14	Kentucky and West Virginia	64,347	.11	14	North Carolina	114,237	.08
15	Connecticut and Massachusetts	34,158	.06	15	Kentucky and West Virginia	86,085	.06
16	Texas	29,535	.05	16	Ohio	35,866	.03
17	Ohio	22,320	.04	17	Texas	34,003	.02
18	Maryland	14,062	.02	18	Maryland	29,105	.02
	Total	56,889,734	100.00		Total	140,735,607	100.00

1911.

ORE MARKETED.

Rank.	State.	Quantity, in long tons.	Percentage of total production.	Rank.	State.	Amount.	Percentage of total value.
1	Minnesota	23,398,406	57.08	1	Minnesota	$48,447,760	56.06
2	Michigan	8,944,393	21.82	2	Michigan	23,808,935	27.55
3	Alabama	3,955,582	9.65	3	Alabama	4,876,106	5.64
4	New York	1,057,984	2.58	4	New York	2,959,009	3.42
5	Virginia	610,871	1.49	5	Wisconsin	1,386,616	1.60
6	Wisconsin	559,763	1.37	6	New Jersey	1,158,271	1.34
7	Pennsylvania	514,929	1.26	7	Virginia	1,146,188	1.33
8	Tennessee	469,728	1.15	8	Tennessee	632,339	.73
9	New Jersey	359,721	.88	9	Pennsylvania	539,553	.62
10	Georgia	207,279	.50	10	Georgia	315,704	.37
11	Maryland and North Carolina	92,382	.22	11	Maryland and North Carolina	161,929	.19
12	Missouri	72,788	.18	12	Missouri	153,676	.18
13	Kentucky and West Virginia	71,979	.18	13	Kentucky and West Virginia	92,575	.11
14	Ohio	16,697	.04	14	Ohio	30,549	.04
	Other States [a]	657,306	1.60		Other States [a]	710,620	.82
	Total	40,989,808	100.00		Total	86,419,830	100.00

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[a] California, Colorado, Connecticut, Massachusetts, Mississippi, New Mexico, and Wyoming.

IRON ORE MARKETED BY VARIETIES BY STATES AND MINING DISTRICTS.

Iron minerals are classified as sulphides, oxides, carbonates, silicates, etc., of which only the oxides and the carbonates are used in the iron and steel industry, except a very small quantity of by-product from sulphide ores used in acid manufacture. The ores of iron are generally classed under four heads:

1. *Hematite.*—Including all the anhydrous sesquioxides (Fe_2O_3—theoretical percentage of iron, 70). This is known locally as red hematite, specular ore, gray ore, fossil ore, oolitic ore, etc.
2. *Brown ore.*—Including hydrated sesquioxides, such as limonite, göthite, and turgite ($Fe_2O_3nH_2O$—theoretical percentage of iron, 59.8–66). This is known locally as brown iron ore, brown hematite, bog ore, limonite, etc.
3. *Magnetite.*—Including magnetic oxides (Fe_3O_4—theoretical percentage of iron, 72.4). Magnetite is known generally as magnetic iron ore.
4. *Iron carbonate.*—Including carbonates of various types ($FeCO_3$—theoretical percentage of iron, 48.2). Iron carbonate is known locally as spathic iron ore, kidney ore, black band ore, siderite, etc.

Hematite has always been predominant as an ore of iron, and at present constitutes about nine-tenths of the iron ore produced. Brown ore and magnetite are far below it in importance; each furnishes at present about one-twentieth of the total iron-ore production. The production of iron carbonate is insignificant in comparison with that of the other ores; it constitutes only about 0.04 per cent of the total.

In the following table are shown the quantities of each of the classes of iron ores marketed in the various States during 1910 and 1911:

Production of iron ore in the United States in 1910 and 1911, by States and varieties, in long tons.

1910.

State.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total quantity.
Alabama	3,678,139	1,123,136			4,801,275
California, Colorado, New Mexico, Washington, and Wyoming	656,629	15,975	189,246		861,850
Connecticut and Massachusetts		34,158			34,158
Georgia	60,324	253,554			313,878
Kentucky and West Virginia	47,493	16,854			64,347
Maryland		14,062			14,062
Michigan	13,303,906				13,303,906
Minnesota	31,966,769				31,966,769
Missouri	55,832	22,509			78,341
New Jersey		(a)	[a] 521,832		521,832
New York	64,738	(a)	[a] 1,222,471		1,287,209
North Carolina			65,278		65,278
Ohio				22,320	22,320
Pennsylvania	846	106,544	632,409		739,799
Tennessee	301,838	430,409			732,247
Texas		29,535			29,535
Virginia	81,647	821,131	599		903,377
Wisconsin	1,148,846	705			1,149,551
Total	51,367,007	2,868,572	2,631,835	22,320	56,889,734

[a] Brown ore is included in magnetite.

Production of iron ore in the United States in 1910 and 1911, by States and varieties, in long tons—Continued.

1911.[a]

State.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total quantity.
Alabama	3,119,696	835,886			3,955,582
Georgia	18,545	188,734			207,279
Kentucky and West Virginia	57,770	14,209			71,979
Maryland and North Carolina		7,600	84,782		92,382
Michigan	8,944,393				8,944,393
Minnesota	23,398,406				23,398,406
Missouri	60,479	12,309			72,788
New Jersey		(b)	[a] 359,721		359,721
New York	29,790		1,028,194		1,057,984
Ohio				16,697	16,697
Pennsylvania	9,792	50,394	454,743		514,929
Tennessee	251,083	218,645			469,728
Virginia	68,139	541,870	862		610,871
Wisconsin	559,763				559,763
Other States [c]	479,922	31,692	145,692		657,306
Total	36,997,778	1,901,339	2,073,994	16,697	40,989,808

[a] Quantities marketed.
[b] Brown ore is included in magnetite.
[c] California, Colorado, Connecticut, Massachusetts, Mississippi, New Mexico, and Wyoming.

From this table it will be seen that the great bulk of the hematite comes from the Lake Superior district (Michigan, Minnesota, and Wisconsin) and Alabama, the bulk of the brown ore from the Appalachian States, and the magnetite from New York, New Jersey, and Pennsylvania. All the iron carbonate is obtained from Ohio. On a later page is given the production of the principal ranges in the Lake Superior district. In the report for 1909 the production was given for the first time of two important southern mining centers, the Birmingham and the Chattanooga districts. In the Birmingham district are included, besides the mines in the immediate vicinity of Birmingham, those in eastern Alabama that ship ores to the furnaces at Birmingham. In the Chattanooga district are included those mines that ship ores to Chattanooga, Dayton, and Rockwood, Tenn., to Rome, Ga., and to Anniston, Ironaton, Rockrun, Gadsden, Alabama City, and Attalla, Ala. The brown ore mines near Russellville, Ala., and in west-central Tennessee are not included in either district.

The following table presents the production of iron ore in the principal mining districts and by varieties during 1910 and 1911:

Production of iron ore in the United States, by mining districts and varieties, in 1910 and 1911, in long tons.

1910.

District.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
Lake Superior	46,328,743				46,328,743
Birmingham	3,300,433	501,682			3,802,115
Chattanooga	712,817	500,742			1,213,559
Adirondack	(a)		[a] 1,146,080		1,146,080
Northern New Jersey and southeastern New York		(b)	[b] 598,601		598,601
Other	1,018,636	1,866,148	893,532	22,320	3,800,636
Total	51,360,629	2,868,572	2,638,213	22,320	56,889,734

[a] Hematite is included in magnetite.
[b] Brown ore is included in magnetite.

Production of iron ore in the United States, by mining districts and varieties, in 1910 and 1911, in long tons—Continued.

1911.

District.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
Lake Superior	32,783,163				32,783,163
Birmingham	2,853,993	412,531			3,266,524
Chattanooga	521,006	396,618			917,624
Adirondack			902,930		902,930
Northern New Jersey and southeastern New York		(a)	484,985		484,985
Other	839,616	1,092,190	686,079	16,697	2,634,582
Total	36,997,778	1,901,339	2,073,994	16,697	40,98[illegible],808

a Brown ore is included in magnetite.

TOTAL PRODUCTION OF IRON ORE.

In the following table is shown the production of various types of iron ore in the United States as far as has been recorded. The statistics from 1889 to the present were collected by the United States Geological Survey; those for 1860, 1870, and 1880 were collected for the census reports of those years; those for 1875 and 1881 were estimated by I. L. Bell;[1] and those from 1882 to 1888, inclusive, were estimated by James M. Swank[2] from the pig-iron production. The figures for 1909 represent ore marketed. No figures can be obtained for the production of various classes of iron ores prior to 1889, except for the census year 1880.

Production of iron ore in the United States, 1860–1911, in long tons.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
1860					2,873,460
1870					a 3,831,891
1875					4,017,857
1880	2,243,993	1,918,622	2,134,276	823,471	7,120,362
1881					7,119,643
1882					b 8,700,000
1883					b 8,800,000
1884					b 7,718,129
1885					b 7,600,000
1886					b 10,000,000
1887					b 11,300,000
1888					b 12,062,530
1889	9,056,288	2,523,087	2,506,415	432,251	14,518,041
1890	10,527,650	2,559,938	2,570,838	377,617	16,036,043
1891	9,327,398	2,757,564	2,317,108	189,108	14,591,178
1892	11,646,619	2,485,101	1,971,965	192,981	16,296,666
1893	8,272,637	1,849,272	1,330,886	134,834	11,587,629
1894	9,347,434	1,472,748	972,219	87,278	11,879,679
1895	12,513,995	2,102,358	1,268,222	73,039	15,957,614
1896	12,576,288	2,126,212	1,211,526	91,423	16,005,449
1897	14,413,318	1,961,954	1,059,479	83,295	17,518,046
1898	16,150,684	1,989,681	1,237,978	55,373	19,433,716
1899	20,004,399	2,869,785	1,727,430	81,559	24,683,173
1900	22,708,274	3,231,089	1,537,551	76,247	27,553,161
1901	24,006,025	3,016,715	1,813,076	51,663	28,887,479
1902	30,532,149	3,305,484	1,688,860	27,642	35,554,135
1903	30,328,654	3,080,399	1,575,422	34,833	35,019,308
1904	23,839,477	2,146,795	1,638,846	19,212	27,644,330
1905	37,567,055	2,546,662	2,390,417	21,999	42,526,133
1906	42,481,375	2,781,063	2,469,294	17,996	47,749,728
1907	46,060,486	2,957,477	2,679,067	23,589	51,720,619
1908	31,788,564	c 2,561,825	c 1,547,797	26,585	d 35,924,771
1909	46,208,640	c 2,700,431	c 2,229,839	16,527	d 51,155,437
1910	51,367,007	c 2,868,572	c 2,631,835	22,320	d 56,889,734
1911	36,997,778	c 1,901,339	c 2,073,994	16,697	d 43,550,633

a Includes ore produced by owners of blast furnaces, estimated by census at 800,000 tons.

b Figures given are for consumption of domestic ores. Total production for 1882, 1883, and 1884 is estimated as 9,000,000, 8,400,000, and 8,200,000 tons, respectively. See Mineral Resources U. S. for 1883 and 1884.

c Some brown ore included in magnetite.

d Ore used for fluxing purposes excluded from production figures after 1907. In 1910 and 1911 ore sold for paint excluded from iron-ore production and included in metallic paint.

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[1] Bell, I. L., Principles of the manufacture of iron and steel, 1884, p. 451.

[2] Mineral Resources U. S., 1882 to 1888.

In the following table the production of iron ore in the United States is shown from 1810 to 1869, and by decades from 1870 to 1909. The figures for the years previous to 1889 were calculated from the pig-iron production and include imported ore as well as domestic ore used. Ore used for flux has been deducted from the production in 1908 and 1909.

Production of iron ore in the United States from 1810 to 1909, by decades, and rate of increase.

Decade.	Quantity in long tons.	Percentage of increase.	Decade.	Quantity in long tons.	Percentage of increase.
1810–1869	49,656,000		1890–1899	163,989,193	80.1
1870–1879	44,570,527		1900–1909 [a]	383,735,101	134.0
1880–1889	91,043,854	104.3			

[a] Iron ore used for flux excluded from production for 1908 and 1909.

PRINCIPAL IRON-ORE MINES.

During 1911, of the 374 iron-ore mines that reported sales or consumption of ore, 159 mines produced over 50,000 long tons of iron ore each, as compared with 191 mines in 1910. The largest quantity produced by any single mine in 1911 was 1,553,510 long tons, from the Hill mine at Marble, on the Mesabi range, Minnesota. Six mines in Minnesota, besides one group in Alabama, produced more than 1,000,000 tons each, and the second largest quantity was 1,343,064 long tons, produced by the Canisteo mine at Coleraine, also on the Mesabi range. Permission has been granted to the Survey by the owners and operators of 123 of these mines to publish their production, and this information is given in the following table:

Iron-ore mines of the United States that produced more than 50,000 long tons each in 1911.

Rank.	Name of mine.	State.	Nearest town.	Variety of ore.	Quantity.
1	Hill	Minnesota	Marble	Hematite	1,553,510
2	Canisteo	do	Coleraine	do	1,343,064
3	Leonard	do	Chisholm	do	1,298,170
4	Sauntry-Alpena	do	Virginia	do	1,057,839
5	Mahoning	do	Hibbing	do	1,011,945
6	Dale	do	do	do	1,004,848
7	Genoa	do	Gilbert	do	924,454
8	Holman	do	Taconite	do	780,665
9	Uno	do	Hibbing	do	745,995
10	Chisholm	do	Chisholm	do	724,798
11	Shenango	do	do	do	709,159
12	Norrie group	Michigan	Ironwood	do	702,051
13	Virginia group	Minnesota	Virginia	do	649,675
14	Spruce	do	Eveleth	do	638,773
15	Newport	Michigan	Ironwood	do	555,853
16	Clark	Minnesota	Chisholm	do	503,597
17	Woodward	Alabama	Woodward	do	502,471
18	Stevenson	Minnesota	Hibbing	do	500,323
19	Hull-Rust	do	do	do	496,977
20	Witherbee, Sherman & Co., Inc. (Mineville).	New York	Mineville	Magnetite	463,827
21	Kinney	Minnesota	Kinney	Hematite	456,107
22	Cornwall	Pennsylvania	Miners Village	Magnetite	454,218
23	Zenith	Minnesota	Ely	Hematite	449,727
24	Fayal	do	Eveleth	do	443,804
25	Penn	Michigan	Vulcan	do	431,200
26	Adams	Minnesota	Eveleth	do	411,749
27	Pioneer	do	Ely	do	401,430
28	Chapin	Michigan	Iron Mountain	do	357,598
29	Mary Charlotte, Nos. 1 and 2.	do	Negaunee	do	343,434

Iron-ore mines of the United States that produced more than 50,000 long tons each in 1911—Continued.

Rank.	Name of mine.	State.	Nearest town.	Variety of ore.	Quantity.
30	Tobin	Michigan	Crystal Falls	Hematite	333,798
31	Mississippi	Minnesota	Keewatin	do.	329,032
32	Bristol	Michigan	Crystal Falls	do.	322,647
33	Queen group	do.	Nogaunee	do.	297,675
34	Commodore	Minnesota	Virginia	do.	294,787
35	Harold	do.	Hibbing	do.	281,943
36	Miller	do.	Aurora	do.	247,557
37	Hawkins	do.	Nashwauk	do.	240,077
38	Dunn	Michigan	Crystal Falls	do.	232,092
39	Laura	Minnesota	Hibbing	do.	210,397
40	Biwabik	do.	Biwabik	do.	209,000
41	Whiteside	do.	Buhl	do.	207,707
42	Aragon	Michigan	Norway	do.	201,269
43	Riverton group	do.	Iron River	do.	200,142
44	Aurora	do.	Ironwood	do.	181,859
45	Bessemer, No. 3 shaft	Minnesota	Virginia	do.	179,055
46	Brown Mining Co	Tennessee	Cardiff	do.	178,819
47	Raimund, No. 1	Alabama	Bessemer	do.	178,793
48	Port Henry, No. 21	New York	Mineville	Magnetite	176,251
49	Lake Superior	Michigan	Ishpeming	Hematite	174,874
50	American-Boston	do.	Diorite	do.	174,723
51	Lake Angeline	do.	Ishpeming	do.	167,258
52	Caspian	do.	Palatka	do.	165,660
53	Sliver	Minnesota	Virginia	do.	165,510
54	Elba	do.	McKinley	do.	165,055
55	Songo	Alabama	Birmingbam	do.	161,912
56	Yale	Michigan	Bessemer	do.	155,487
57	Agnew	Minnesota	Hibbing	do.	153,373
58	Montreal	Wisconsin	Hurley	do.	153,122
59	Kennedy	Minnesota	Cuyuna	do.	147,431
60	Tilden	Michigan	Bessemer	do.	138,387
61	Brunt	Minnesota	Mountain Iron	do.	135,189
62	Baltic	Michigan	Palatka	do.	134,118
63	Albany	Minnesota	Hibbing	do.	132,573
64	Raimund, No. 2	Alabama	Bessemer	do.	131,314
65	Pettit	Minnesota	Gilbert	do.	129,776
66	Mace	do.	Hibbing	do.	125,013
67	Mohawk	do.	Aurora	do.	121,822
68	Schley	do.	Gilbert	do.	120,365
69	Republic	Michigan	Republic	do.	120,089
70	Bangor	Minnesota	Biwabik	do.	119,508
71	Cary	Wisconsin	Hurley	do.	119,169
72	Hiawatha	Michigan	Iron River	do.	116,736
73	Glen	Minnesota	Chisholm	do.	113,512
74	Monica	do.	Biwabik	do.	112,952
75	Clinton	Alabama	Steinman	do.	111,374
76	Zimmerman	Michigan	Stambaugh	do.	110,084
77	Hemlock	do.	Amasa	do.	105,320
78	Richard	New Jersey	Wharton	Magnetite	104,560
79	Mayville	Wisconsin	Mayville	Hematite	101,679
80	Leonard-Burt	Minnesota	Chisholm	do.	100,723
81	Utica	do.	Hibbing	do.	100,123
82	Crudup	Alabama	Gadsden	do.	99,486
83	Eureka	Michigan	Ramsay	do.	98,609
84	Virginia	Minnesota	Eveleth	do.	97,667
85	Florenco	Wisconsin	Florenca	do.	96,560
86	Myers	Minnesota	Chisholm	do.	93,203
87	Savoy	do.	Ely	do.	87,964
88	Sellers	do.	Hibbing	do.	87,324
89	Cranberry	North Carolina	Cranberry	Magnetite	84,782
90	Raimund, No. 3	Alabama	Bessemer	Hematite	84,775
91	Great Western	Michigan	Crystal Falls	do.	84,338
92	Woodstock	Alabama	Woodstock	Brown ore	83,362
93	Houston	do.	Rickoy	do.	82,857
94	Leonard-Glen	Minnesota	Chisholm	Hematite	82,719
95	Cyprus	do.	Hibbing	do.	81,318
96	Pearson	do.	Nashwauk	do.	75,138
97	Breitung Hematite, No. 2	Michigan	Negaunee	do.	74,933
98	Clifford and Traders	do.	Iron Mountain	do.	74,138
99	Adriatic	Minnesota	Mesabi	do.	73,280
100	Minorca	do.	Virginia	do.	67,942
101	Cambria	Michigan	Negaunee	do.	67,869
102	Hudson	Minnesota	Aurora	do.	67,278
103	Franklin	do.	Virginia	do.	66,350
104	Soudan	do.	Soudan	do.	65,350
105	Brotherton	Michigan	Wakefield	do.	65,015
106	Breitung Hematite, No. 1	do.	Negaunee	do.	64,643
107	Corsica	Minnesota	McKinley	do.	63,940
108	Onondaga	do.	Virginia	do.	63,798
109	Ironton	Michigan	Bessemer	do.	63,402
110	Barron	do.	Humboldt	do.	60.731

Iron-ore mines of the United States that produced more than 50,000 long tons each in 1911—Continued.

Rank.	Name of mine.	State.	Nearest town.	Variety of ore.	Quantity.
111	Mannie	Tennessee	Allens Creek	Brown ore	59,285
112	Chatham	Michigan	Iron River	Hematite	58,056
113	Rose Run	Kentucky	Olympia	do	57,770
114	Euclid	Minnesota	Chisholm	do	57,598
115	Gibson	Michigan	Amasa	do	57,099
116	Madeira	Minnesota	Hibbing	do	57,098
117	Burt	do	do	do	56,576
118	Sunday Lake	Michigan	Wakefield	do	56,096
119	Mansfield	do	Crystal Falls	do	54,646
120	Winifred	Minnesota	Hibbing	do	52,414
121	Volunteer	Michigan	Negaunee	do	51,864
122	Armenia	do	Crystal Falls	do	51,862
123	Chandler	Minnesota	Ely	do	50,206
	Total (123 mines)				31,788,293
	Unspecified (36 mines)[a]				6,141,435
	Grand total				37,929,728

[a] Includes the product of 36 mines producing over 50,000 long tons each, operated by 19 companies, which do not permit the publication of individual statistics.

STOCKS OF IRON ORE AT MINES.

Considerable stock was left at the mines at the end of 1911 which is not included in the marketed totals. On December 31, 1911, this stock amounted to 11,969,060 tons, as compared with 9,408,235 tons on December 31, 1910. Besides this stock at the mines, stocks are left at receiving ports and furnaces, but these are included in the total sales of ore.

The following table shows the tonnage of stock (exclusive of 30,050 long tons in 1910 and 5,425 tons in 1911 at mines which produce ore for flux only) left at the mines on December 31, 1910 and 1911, in the various States:

Stock of iron ore on hand at the mines Dec. 31, 1910 and 1911, by States, in long tons.

State.	1910	1911	State.	1910	1911
Alabama	716,340	588,549	Pennsylvania	11,839	33,116
Georgia	4,090	700	Tennessee	14,848	8,955
Maryland	1,020	4,000	Texas	10,600	24,000
Massachusetts	4,281	4,200	Virginia	11,348	14,500
Michigan	4,698,565	6,069,025	West Virginia		15,000
Minnesota	3,486,277	4,572,653	Wisconsin	286,266	398,817
Mississippi		50			
Missouri	8,625	1,140	Total	9,408,235	11,969,060
New Jersey	17,567	115,581	Percentage of increase in 1911		27.22
New York	119,139	102,334			
Ohio	17,430	16,440			

PRICE OF IRON ORE PER TON.

In the following table the price per ton of the different classes of iron ore in 1910 and 1911 is given for each of the producing States or groups of States. The total average prices per long ton (considering the whole United States) in 1911 were: Hematite, $2.12; brown ore, $1.65; magnetite, $2.29; carbonate, $1.83, as compared with prices, respectively, of $2.52, $1.76, $2.36, and $1.61 in 1910. These figures represent the value at the mines and are taken directly from statements of the producers. They should be accepted as only approximately correct. The element of inaccuracy arises from the fact that by far the greater bulk of the iron ore produced in the United States is mined by pig iron producers for their own furnaces, and the value placed on such ore is therefore largely a matter of accounting. Some of the reports made to the Survey evidently include merely actual mining costs; others contain an allowance for sinking fund; and in still others the figures given are merely convenient prices to use in charging costs against the blast furnaces.

It is to be noted, however, that the errors are almost entirely in one direction—that of undervaluing the ore rather than of overvaluing it. If all the iron ore were to be bought by blast furnaces in open market from an entirely distinct set of iron-ore producers, the average prices paid would probably exceed those now reported. It is of interest to compare the prices given below with those of the Lake Superior ores at the lower Lake ports given in a subsequent table. If the freight rates by rail from the mines to Duluth, Superior, Marquette, and Escanaba plus the freight rates by water are deducted from prices at lower Lake ports the margin of profit appears small.

Average price per long ton of iron ore in the United States in 1910 and 1911, by States and varieties.

State.	Hematite.		Brown ore.		Magnetite.		Carbonate.	
	1910	1911	1910	1911	1910	1911	1910	1911
Alabama	$1.19	$1.17	$1.53	$1.47	......	......	......	......
Georgia	1.54	1.38	1.53	1.54	......	......	......	......
Kentucky and West Virginia	1.25	1.25	1.59	1.43	......	......	......	......
Maryland and North Carolina	......	......	2.07	1.78	$1.75	$1.75	......	......
Michigan	3.11	2.66	......	......	......	......	......	......
Minnesota	2.45	2.07	......	......	......	......	......	......
Missouri	2.23	2.17	1.96	1.83	......	......	......	......
New Jersey	......	......	3.87	3.70	3.03	3.22	......	......
New York	2.21	2.05	3.00	......	3.03	2.82	......	......
Ohio	......	......	......	......	......	......	$1.61	$1.83
Pennsylvania	2.34	1.87	2.60	2.37	1.00	.88	......	......
Tennessee	1.25	1.26	1.56	1.45	......	......	......	......
Texas	......	......	1.15	......	......	......	......	......
Virginia	1.74	1.58	2.07	1.91	1.50	1.50	......	......
Wisconsin	3.14	2.48	2.50	......	......	......	......	......
Other States[a]	1.00	1.00	3.04	2.65	1.00	1.01	......	......
Total average	2.52	2.12	1.76	1.65	2.36	2.29	1.61	1.83

[a] 1910: California, Colorado, Connecticut, Massachusetts, New Mexico, Washington, and Wyoming; 1911: California, Colorado, Connecticut, Massachusetts, Mississippi, New Mexico, and Wyoming.

APPARENT ANNUAL IRON-ORE CONSUMPTION.

The following table includes data on certain factors from which an approximate estimate of the annual consumption of iron ore in the United States is deduced. The result is, of course, merely an approximation, for no data are available on certain other factors which should enter into the final result. The elements considered in the table and estimates for all years except 1909 and 1911 are (1) domestic iron-ore production; (2) stocks of ore at mines for current year and past year; (3) stocks of ore at lower Lake ports for current year and past year; (4) zinc residuum production; (5) imports of ore; (6)

exports of ore. In 1909 and 1911 the sales, zinc residuum, and the imports constitute the available supply, which, less the exports gives the apparent consumption.

Apparent consumption of iron ore in the United States, 1889–1911, in long tons.

Year.	Domestic iron ore produced.[a]	Stocks of ore at mines.	Stocks of ore at lower Lake ports Dec. 1.	Zinc residuum.	Imports.	Exports.	Apparent consumption.
1889	14,518,041	2,256,973	2,607,106	43,648	853,573	....	14,366,562
1890	16,036,043	2,000,000	3,893,487	48,560	1,246,830	....	16,302,025
1891	14,591,178	2,450,279	3,508,489	38,228	912,864	....	15,476,989
1892	16,296,666	2,911,740	4,149,451	31,859	806,585	....	16,032,687
1893	11,587,629	3,526,161	4,070,710	37,512	526,951	....	11,616,412
1894	11,879,679	3,236,198	4,834,247	26,981	167,307	....	11,600,393
1895	15,957,614	2,976,494	4,415,712	43,249	524,153	....	17,203,255
1896	16,005,449	3,405,302	4,954,984	44,953	682,806	....	15,765,128
1897	17,518,046	3,098,287	5,923,755	33,924	489,970	....	17,380,184
1898	19,433,716	2,846,457	5,136,407	48,502	187,208	....	20,708,604
1899	24,683,173	2,320,278	5,530,283	65,010	674,082	40,665	25,513,903
1900	27,553,161	3,709,950	5,904,670	87,110	897,831	51,460	26,722,583
1901	28,887,479	4,239,823	5,859,663	52,311	966,950	64,703	29,357,171
1902	35,554,135	3,834,717	7,074,254	65,246	1,165,470	88,445	35,886,921
1903	35,019,308	6,297,888	6,371,085	73,264	980,440	80,611	34,232,399
1904	27,644,330	4,666,931	5,763,399	68,189	487,613	213,865	30,224,910
1905	42,526,133	3,812,281	6,438,967	90,289	845,651	208,017	43,433,138
1906	47,749,728	3,281,789	6,252,455	93,461	1,060,390	265,240	49,355,343
1907	51,720,619	3,033,110	7,385,728	93,413	1,229,168	278,608	51,879,998
1908	35,924,771	6,065,397	8,441,533	110,225	776,898	309,099	32,414,703
1909	51,155,437	6,135,171	8,965,789	141,264	1,694,957	455,934	52,535,724
1910	56,889,734	9,408,235	9,426,881	137,173	2,591,031	748,875	56,057,091
1911	40,989,808	....	....	109,296	1,811,732	768,386	42,142,450

[a] Prior to 1908 iron ore used for fluxing included in production. Such ore excluded 1908–1911. Iron ore sold for paint excluded from 1910 and 1911 production and included in metallic paint. In 1909 and 1911 figures represent sales.

COMPARATIVE PRODUCTION OF IRON ORE AND PIG IRON.

Detailed data on the pig-iron production of the United States are presented on later pages of this report, but in the following table an interesting comparison is made between the annual production of iron ore and of pig iron:

Production of iron ore and pig iron in the United States, 1889–1911, in long tons.

Year.	Iron ore produced.[a]	Pig iron produced.[b]	Percentage ratio of pig iron to iron ore.	Year.	Iron ore produced.[a]	Pig iron produced.[b]	Percentage ratio of pig iron to iron ore.
1889	14,518,041	7,603,642	52.4	1901	28,887,479	15,878,354	54.9
1890	16,036,043	9,202,703	57.4	1902	35,554,135	17,821,307	50.1
1891	14,591,178	8,279,870	56.7	1903	35,019,308	18,009,252	51.4
1892	16,296,666	9,157,000	56.2	1904	27,644,330	16,497,033	59.7
1893	11,587,629	7,124,502	61.5	1905	42,526,133	22,992,380	54.0
1894	11,879,679	6,657,388	56.0	1906	47,749,728	25,307,191	53.0
1895	15,957,614	9,446,308	59.2	1907	51,720,619	25,781,361	49.8
1896	16,005,449	8,623,127	53.8	1908	35,924,771	15,936,018	44.3
1897	17,518,046	9,652,680	55.1	1909	51,155,437	25,795,471	50.4
1898	19,433,716	11,773,934	60.6	1910	56,889,734	26,674,123	46.9
1899	24,683,173	13,620,703	55.2	1911	40,989,808	23,257,288	56.7
1900	27,553,161	13,789,242	50.0				

[a] Prior to 1908, iron ore used for fluxing included in production. Such ore excluded 1908–1911. Iron ore sold for paint excluded from 1910 and 1911 production and included in metallic paint. Iron ore marketed in 1911.

[b] From annual reports of the American Iron and Steel Association prior to 1910, and including ferro-alloys produced in blast furnaces. Figures for 1910 and 1911 represent pig iron sold or used (not quantity produced) and do not include ferro-alloys. Statistics for 1910 and 1911 were collected by the Survey.

IRON-ORE INDUSTRY IN THE LAKE SUPERIOR DISTRICT.

Production of iron ore in the Lake Superior district, by ranges.—The Lake Superior district includes the Vermilion, Mesabi, Cuyuna, Penokee-Gogebic, Marquette, and Menominee ranges in the States of Minnesota, Michigan, and Wisconsin. The Menominee range includes the Crystal Falls, Metropolitan, Iron River, and Florence areas; the Marquette range includes the Republic and Swanzy areas. The Baraboo and Iron Ridge areas of southern Wisconsin and the Spring Valley area of northwestern Wisconsin are frequently also included in the Lake Superior district. In the first group of ranges the ore mined is almost entirely Algonkian hematite, belonging to the Huronian series. The Baraboo ore is of the same nature, but the Iron Ridge ore is Clinton hematite, and the Spring Valley ore is brown ore.

In addition to these ranges, there are several iron-ore districts on the Canadian side of the Great Lakes, the principal ones of which are the Michipicoten, the Animikie, the Matawin, and the Atikokan.

The American ranges which produced ore in 1911 were the Vermilion, Mesabi, Penokee-Gogebic, Marquette, Menominee, and Cuyuna, besides the Baraboo and Iron Ridge areas. Much development work was done on the Cuyuna range, which made its first shipments in 1911. The following table shows the production of the first six of these for 1910 and 1911, as they constitute the Lake Superior district proper.

The Mesabi range produced 67.6 per cent of the entire Lake Superior output and about 54 per cent of the entire production of the United States. The Menominee, Marquette, and Penokee-Gogebic ranges are next in importance, the Menominee producing a little more than the State of Alabama, which is the next State in importance as a producer after Minnesota and Michigan. The Vermilion range, the fifth in importance of the six producing Lake Superior ranges, produced more ore in 1911 than New York, which is fourth in importance as a producing State.

In the following tables is shown the total production of the Lake Superior district by ranges. The figures prior to 1872 were collected by A. P. Swineford, editor Marquette Mining Journal;[1] those for 1872 to 1877, inclusive, are from the Michigan Mineral Statistics; those from 1878 to 1888, inclusive, were collected by W. J. Stevens;[2] and the later figures were collected by the United States Geological Survey.

Production of iron ore in the Lake Superior region, 1910–11, by ranges, in long tons.

Range.	1910	1911 [a]	Increase (+) or decrease (−) in 1911.	Percentage of increase (+) or decrease (−) in 1911.	Percentage of total production in Lake Superior region.
Marquette (Michigan)	4,631,427	2,820,749	− 1,810,678	−39.10	8.60
Menominee (Michigan and Wisconsin)	4,983,729	3,965,859	− 1,017,870	−20.42	12.10
Gogebic (Michigan and Wisconsin)	4,746,818	2,598,149	− 2,148,669	−45.27	7.92
Vermilion (Minnesota)	1,390,360	1,090,874	− 299,486	−21.54	3.33
Mesabi (Minnesota)	30,576,409	22,160,101	− 8,416,308	−27.53	67.60
Cuyuna (Minnesota)	....	147,431	+ 147,431	....	.45
Total	46,328,743	32,783,163	−13,545,580	−29.24	100.00

[a] Shipments.

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[1] Mineral Resources U. S. for 1882, p. 116.

[2] Mineral Resources U. S. for 1891, p. 41.

Production of Lake Superior iron ore, 1854–1911, by ranges, in long tons.

Year.	Marquette.	Menominee.	Gogebic.	Vermilion.	Mesabi.	Cuyuna.	Total.
1854–1869	3,112,209	....	....	....	....	....	3,112,209
1870	859,507	....	....	....	....	....	859,507
1871	813,984	....	....	....	....	....	813,984
1872	948,553	....	....	....	....	....	948,553
1873	1,195,234	....	....	....	....	....	1,195,234
1874	899,934	....	....	....	....	....	899,934
1875	881,166	....	....	....	....	....	881,166
1876	993,311	....	....	....	....	....	993,311
1877	1,014,754	10,375	....	....	....	....	1,025,126
1878	1,033,082	78,028	....	....	....	....	1,111,110
1879	1,130,019	245,672	....	....	....	....	1,375,691
1880	1,384,010	524,735	....	....	....	....	1,908,745
1881	1,579,834	726,671	....	....	....	....	2,306,505
1882	1,829,394	1,136,018	....	....	....	....	2,965,412
1883	1,305,364	1,047,863	....	....	....	....	2,353,227
1884	1,559,912	895,634	1,022	62,122	....	....	2,518,690
1885	1,430,862	690,435	119,590	227,075	....	....	2,467,962
1886	1,627,383	880,006	756,237	307,948	....	....	3,571,574
1887	1,851,717	1,199,343	1,285,265	394,910	....	....	4,731,235
1888	1,918,672	1,191,097	1,433,689	511,953	....	....	5,055,411
1889	2,631,026	1,876,157	2,147,923	864,508	....	....	7,519,614
1890	2,863,848	2,274,192	2,914,081	891,910	....	....	8,944,031
1891	2,778,482	1,856,124	2,041,754	945,105	....	....	7,621,465
1892	2,848,552	2,402,195	3,058,176	1,226,220	29,245	....	9,564,388
1893	2,064,827	1,563,049	1,466,815	815,735	684,194	....	6,594,620
1894	1,935,379	1,255,255	1,523,451	1,055,229	1,913,234	....	7,682,548
1895	1,982,080	1,794,970	2,625,475	1,027,103	2,839,350	....	10,268,978
1896	2,418,846	1,763,235	2,100,398	1,200,907	3,082,973	....	10,566,359
1897	2,673,785	1,767,220	2,163,088	1,381,278	4,220,151	....	12,205,522
1898	2,987,930	2,275,664	2,552,205	1,125,538	4,837,971	....	13,779,308
1899	3,634,596	3,281,422	2,725,648	1,643,984	6,517,305	....	17,802,955
1900	3,945,068	3,680,738	3,104,033	1,675,949	8,158,450	....	20,564,238
1901	3,597,089	3,697,408	3,041,869	1,805 996	9,303,541	....	21,445,903
1902	3,734,712	4,421,250	3,683,792	2,057,532	13,080,118	....	26,977,404
1903	3,686,214	4,093,320	3,422,341	1,918,584	13,452,812	....	26,573,271
1904	2,465,448	2,871,130	2,132,898	1,056,430	11,672,405	....	20,198,311
1905	3,772,645	4,472,630	3,344,551	1,578,626	20,156,566	....	33,325,018
1906	4,070,914	4,962,357	3,484,023	1,794,186	23,564,891	....	37,876,371
1907	4,167,810	4,779,592	3,609,519	1,724,217	27,245,441	....	41,526,579
1908	3,309,917	2,904,011	3,241,931	927,206	17,725,014	....	28,108,079
1909	4,291,967	4,789,362	3,807,157	1,097,444	27,877,705	....	41,863,635
1910	4,631,427	4,983,729	4,746,818	1,390,360	30,576,409	....	46,328,743
1911 [a]	2,820,749	3,965,859	2,598,149	1,090,874	22,160,101	147,431	32,783,163
Total	100,682,212	80,356,746	69,131,898	31,798,929	249,097,876	147,431	531,215,092

[a] Shipments.

Shipments and receipts of Lake Superior ore.— According to the Iron Trade Review 32,793,130 long tons of iron ore were shipped from the Lake Superior district. Of this total 662,719 tons were shipped by rail, the remainder being by boat. In 1911 the Survey statistics are based on marketed ore, which is practically the same as shipments in the case of the Lake ores, consequently the total given below for 1911 agrees closely with the figures as reported to the Survey. Details concerning the shipments and receipts of these ores are given in the following tables:

Shipments of Lake Superior iron ore, 1906–1911, in long tons.[a]

Shipping port.	1906	1907	1908	1909	1910	1911
Escanaba, Mich	5,851,050	5,761,988	3,351,502	6,747,801	4,949,726	4,278,445
Marquette, Mich	2,791,033	3,013,826	1,487,487	2,909,451	3,248,516	2,200,380
Ashland, Wis	3,388,106	3,436,867	2,513,670	3,834,207	4,094,374	2,429,290
Two Harbors, Minn	8,180,125	8,188,906	5,702,237	9,181,132	8,271,177	6,367,537
Superior, Wis	6,083,057	7,440,386	3,564,030	6,540,505	8,414,799	9,920,490
Duluth, Minn	11,220,218	13,448,736	8,808,168	13,470,503	13,640,166	6,934,269
Total by lake	37,513,589	41,290,709	25,427,094	41,683,599	42,618,758	32,130,411
Total by rail	1,052,173	975,959	587,893	903,270	823,639	662,719
Total	38,565,762	42,266,668	26,014,987	42,586,869	43,442,397	32,793,130

[a] Iron Trade Review.

Iron-ore receipts at Lake Erie ports, 1906–1911, in long tons.[a]

Port.	1906	1907	1908	1909	1910	1911
Toledo	1,423,741	1,314,140	680,553	1,374,224	1,225,202	493,345
Sandusky	35,847	83,043		11,088		
Huron	778,453	971,430	213,377	243,082	197,951	223,947
Lorain	2,191,965	2,621,025	2,286,388	2,796,856	2,884,738	2,937,605
Cleveland	6,604,661	6,495,998	4,240,815	6,051,342	6,344,943	4,584,211
Fairport	1,861,498	2,437,649	1,518,961	1,734,277	1,516,434	666,365
Ashtabula	6,833,352	7,521,859	3,012,064	8,056,941	9,620,638	6,359,131
Conneaut	5,432,370	5,875,937	4,798,631	7,007,834	6,309,548	6,931,278
Erie	1,986,539	2,294,239	828,502	1,235,057	942,592	289,400
Buffalo	4,928,381	5,580,438	2,835,099	5,002,235	4,704,439	2,802,976
Detroit				159,889	296,412	243,292
Total	32,076,757	35,195,758	20,414,491	33,672,825	34,042,807	25,531,550

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[a] Iron Trade Review.

The difference between the shipments of Lake Superior ore and the receipts at Lake Erie ports is accounted for mainly by the quantity of ore delivered at Lake Michigan ports, Chicago, Ill., Gary, Ind., and Milwaukee, Wis.

The following table shows the total quantity of iron ore shipped from the Lake Superior district since 1854, the date of the opening of the Marquette range, the oldest of the Lake Superior ranges. This table gives the shipments as collected by the Iron Trade Review and is inserted for comparison with the table giving the total production of the Lake Superior district, without regard to shipments:

Shipments of iron ore from the Lake Superior region, 1854–1911, in long tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1854	3,000	1874	919,557	1894	7,748,932
1855	1,449	1875	891,257	1895	10,429,037
1856	36,343	1876	992,764	1896	9,934,828
1857	25,646	1877	1,015,087	1897	12,469,638
1858	15,876	1878	1,111,110	1898	14,024,673
1859	68,832	1879	1,375,691	1899	18,251,804
1860	114,401	1880	1,908,745	1900	19,059,393
1861	49,909	1881	2,306,505	1901	20,589,237
1862	124,169	1882	2,965,412	1902	27,571,121
1863	203,055	1883	2,353,288	1903	24,289,878
1864	243,127	1884	2,518,692	1904	21,822,839
1865	236,208	1885	2,466,372	1905	34,384,116
1866	278,796	1886	3,568,022	1906	38,565,762
1867	473,567	1887	4,730,577	1907	42,266,668
1868	491,449	1888	5,063,693	1908	26,014,987
1869	617,444	1889	7,292,754	1909	42,586,869
1870	830,940	1890	9,012,379	1910	43,442,397
1871	779,607	1891	7,062,233	1911	32,793,130
1872	900,901	1892	9,069,556		
1873	1,162,458	1893	6,060,492	Total	525,586,672

Stocks of iron ore at Lake Erie ports.—At the close of navigation in 1910 the stocks of iron ore at the Lake Erie ports exceeded those of the same date in 1909 by 461,092 tons, and the stocks of 1909 exceeded those of 1908 by 524,256 tons, but in 1911 the stocks amounted to 295,217 tons less than in 1910.

The following tables contain data as to the stocks of iron ore at the Lake Erie ports at the close of navigation and at the opening of navigation for the last six years:

Stocks of iron ore at lower Lake ports, Dec. 1, 1906–1911, in long tons.[a]

Port.	At close of navigation, Dec. 1—					
	1906	1907	1908	1909	1910	1911
Toledo, Ohio	281,000	518,645	590,925	332,456	433,215	661,382
Sandusky, Ohio	17,467	44,546	36,079	39,557	17,728	2,471
Huron, Ohio	245,499	415,730	458,158	477,333	375,118	344,371
Lorain, Ohio	336,321	366,271	426,274	407,129	259,448	314,321
Cleveland, Ohio	1,224,606	1,281,335	1,458,392	1,547,142	1,038,795	1,589,491
Fairport, Ohio	590,783	523,981	835,821	867,640	839,970	636,566
Ashtabula, Ohio	1,631,312	2,050,820	2,293,531	2,594,359	3,287,816	3,295,862
Conneaut, Ohio	1,057,424	1,000,774	1,296,675	1,411,002	1,329,997	1,237,573
Erie, Pa	552,631	652,219	730,530	788,046	792,011	636,274
Buffalo, N. Y	315,412	435,407	315,148	501,125	452,783	413,353
Total	6,252,455	7,385,728	8,441,533	8,965,789	9,426,881	9,131,664

[a] Iron Trade Review.

Stocks of iron ore at lower Lake ports, May 1, 1906–1912, in long tons.[a]

Port.	At opening of navigation, May 1—						
	1906	1907	1908	1909	1910	1911	1912
Ashtabula, Ohio	462,564	568,485	1,799,454	1,392,430	1,609,931	2,277,931	2,108,749
Cleveland, Ohio	350,382	447,573	1,029,198	1,018,055	985,725	1,562,858	1,363,696
Fairport, Ohio	266,162	154,246	225,328	562,679	541,299	633,485	381,705
Erie, Pa	169,488	189,276	595,660	557,029	550,187	653,778	585,150
Lorain, Ohio	140,452	176,300	327,052	362,096	205,445	346,849	287,294
Conneaut, Ohio	148,528	139,853	462,392	497,203	461,365	419,421	229,462
Toledo, Ohio	52,550	147,397	217,788	380,675	366,631	383,761	356,102
Huron, Ohio	80,738	98,106	392,731	379,364	336,693	273,042	257,496
Buffalo, N. Y	90,906	50,313	388,441	189,209	364,336	347,702	309,120
Sandusky, Ohio	29,320	5,439	42,256	31,528	22,468	11,458	2,471
Total	1,791,090	1,976,988	5,480,300	5,370,268	5,444,080	6,850,285	5,881,245

[a] Iron Trade Review.

Prices of Lake Superior iron ore.—In the following table are given the prices of Lake Superior iron ore at the lower Lake ports during 1910 and 1911.

The base for the Bessemer ore is a metallic iron content of 55 per cent; that of the non-Bessemer ore is a metallic iron content of 51.5 per cent:

Base prices per long ton of Lake Superior iron ore at lower Lake ports, 1910–11.

	1910 [a]	1911 [b]		1910 [a]	1911 [c]
Old range:			Mesabi:		
Bessemer	$5.00	$4.50	Bessemer	$4.75	$4.25
Non-Bessemer	4.20	3.70	Non-Bessemer	4.00	3.50

[a] Iron Trade Review, Jan. 13, 1910.
[b] Bull. Am. Iron and Steel Assoc. for 1910, p. 36.
[c] Iron Trade Review, Jan. 4, 1912, p. 29.

Cuyuna range.—With the advent of the Cuyuna range into the producing field the following brief note on the condition of developments and the outlook at the close of 1911 is of interest:[1]

> In the past year the first shipments of iron ore from the Cuyuna range in Minnesota have been made. The total amount moved was 147,000 tons, taken from the Kennedy

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[1] Woodbridge, D. E., Lake Superior ore developments: Iron Age, Jan. 4, 1912, p. 67.

mine of the Rogers-Brown Ore Co. and shipped over the new branch of the Soo Line to the new ore docks of that road at Superior, Wis. The ore shipped was representative of the average product that may be expected to come from this district in the next few years, although an important portion of the tonnage so far proved up will run considerably higher in iron content. The shipments of the past year averaged between 45 and 46 per cent metallic iron, natural, and in other constituents and characteristics the ore was decidedly desirable. The plans for shipments next year contemplate the movement of 200,000 tons from the Kennedy mine, 100,000 tons from the Armour mine, owned by the Iroquois Iron Co., and a like amount from the Thompson mine of the Inland Steel Co. This iron is expected to grade from 46 per cent in iron, natural, up to 51 per cent.

* * * The iron formation of this district embraces two ranges, known as the North and the South. While the Adams syndicate is now actively engaged in sinking a concrete shaft on the South range at a property drilled and abandoned by the Rogers-Brown Ore Co., and M. A. Hanna & Co. are exploring a property southwest of Brainard, the major portion of the year's development has been confined to the North range. In addition to the operation of its Kennedy mine, the Rogers-Brown Ore Co. put down a concrete shaft on its Meacham property. After the sinking of the shaft development work on this property was discontinued pending an improvement in the condition of the ore market. This company is also conducting the development work of the Armour mine mentioned above. On the forty adjoining that of the Armour deposit the Inland Steel Co. has put down a concrete shaft, and more recently Oglebay, Norton & Co., Cleveland, have taken over a proved deposit from the C. M. Hill Lumber Co. and are now checking the drill holes preparatory to putting down a shaft.

Conditions thus far encountered have made it advisable hereafter to build shafts of concrete, which work has been done by the Foundation Co. of New York. The development work of the year has served to establish somewhat more clearly the character of the Cuyuna ore-bearing formation. The feeling has existed in the past that drilling for ore in this field was largely a hit or miss proposition. This is still true to a degree because of the peculiar interruptions of the continuity of the ore lenses. The general trend of the North range has been followed as far as Mississippi River. It is not continuous, however, but consists of parallel lenses of irregular location and extent. The ore formation stands at an angle of from 50° to 70°, and the ore bodies, although they may easily be missed by drill, admit of opening up and working to advantage.

FOREIGN TRADE IN IRON ORE.

IMPORTS.

The quantity of iron ore imported into the United States in 1911 was 1,811,732 long tons, valued at $5,412,636, or $2.99 per ton. This represents a decrease in quantity of 779,299 tons (30 per cent) and in value of $2,419,589, as compared with the imports during 1910, which were 2,591,031 long tons, valued at $7,832,225, or $3.02 per ton. The imports in 1910 increased 53 per cent over those of 1909, and the sudden checking of the imports in 1911 indicates how closely the course of imports parallels the local production. As to the source of the imports in 1911, Cuba produced 63 per cent of the ore, Sweden 12 per cent, Spain 11 per cent, Newfoundland and Labrador 10 per cent, Canada 3 per cent, with minor quantities from Greece, French Africa, Great Britain, the Netherlands, and other countries.

The statistics of imports of iron ore are furnished by the Bureau of Statistics, Department of Commerce and Labor, and the following table gives the imports from the various countries from 1908 to 1911:

Quantity and value of iron ore imported into the United States in the calendar years 1908–1911, by countries, in long tons.

Country.	1908		1909		1910		1911	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Cuba	579,668	$1,756,091	927,774	$2,681,028	1,451,096	$4,459,789	1,147,879	$3,218,485
Spain	126,074	331,070	291,547	664,460	439,868	1,040,589	194,965	602,453
French Africa			37,208	67,515	15,471	36,791	4,443	13,068
Greece	4,850	5,311	19,080	21,782	39,060	71,951	13,200	18,888
Newfoundland and Labrador	48,285	48,285	224,395	330,056	209,006	343,892	174,853	286,997
United Kingdom	2,028	32,027	869	12,846	11,388	52,591	1,436	19,725
Germany	602	4,052	3	100	3	58	2	76
Netherlands							223	420
Canada	5,013	16,321	27,155	84,613	95,005	251,086	60,480	106,038
Belgium	1	28	3	179	158	644		
Russia in Europe			32,010	62,418	12,570	48,279		
Sweden	4,617	15,783	120,564	627,315	259,911	1,391,976	219,238	1,215,588
Other countries	5,760	15,280	[a] 14,349	26,766	[b] 57,495	134,579	5,013	30,898
Total	776,898	2,224,248	1,694,957	4,579,078	2,591,031	7,832,225	1,811,732	5,412,636

[a] Other countries in 1909; Colombia and Mexico.

[b] Other countries in 1910: Chinese Empire, Colombia, Egypt, British South Africa, etc.

The following table shows the imports of iron ore into the United States from 1907 to 1911, inclusive, by ports of entry:

Quantity and value of iron ore imported into the United States in the calendar years 1908–1911, by customs districts, in long tons.

Customs district.	1908		1909		1910		1911	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Baltimore	248,875	$844,436	628,577	$1,838,762	1,137,916	$3,576,059	806,354	$2,305,042
Boston	21	61	7	29	235	853	100	272
Charleston	500	3,070						
New York	4,392	17,424	47,285	93,277	78,556	213,282	11,263	32,077
Perth Amboy	1,355	23,637						
Philadelphia	516,619	1,318,182	991,983	2,559,760	1,269,180	3,775,770	984,192	3,039,994
Savannah								
Chicago					7,679	22,610		
Los Angeles	51	501						
Puget Sound					25,000	47,750		
San Francisco	50	446					10	250
Buffalo Creek			141	489	4,200	4,473	2,730	5,255
Champlain	10	30	40	75	29	73	146	1,904
Cuyahoga	1,712	3,030	3,500	15,250			2,902	6,675
Detroit			25	777	306	765	23	105
Erie			4,000	16,700				
Miami	2,569	9,403	18,106	46,106	63,966	172,824		
Niagara	23	40	596	2,310	2,343	11,166	1,668	8,343
Oswegatchie	23	60			25	75	50	160
Vermont	676	3,758	455	2,054	137	1,509	47	188
St. Louis	22	170					70	1,034
Genesee			17	895	10	553	13	527
Other dstricts			225	2,594	1,449	5,463	2,164	10,820
Total	776,898	2,224,248	1,694,957	4,579,078	2,591,031	7,832,225	1,811,732	5,412,636

In the following table is shown the importation of iron ore into the United States as far as has been recorded. Iron ore was imported from Europe in large quantities for the first time in 1879, most of the ore prior to that date coming from Canada:

Imports of iron ore into the United States, 1872–1911, in long tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1872	23,733	1885	390,786	1899	674,082
1873	45,981	1886	1,039,433	1900	897,831
1874	57,987	1887	1,194,301	1901	966,950
1875	56,655	1888	587,470	1902	1,165,470
1876	17,284	1889	853,573	1903	980,440
1877	30,669	1890	1,246,830	1904	487,613
1878	28,212	1891	912,864	1905	845,651
1879 [a]	150,197	1892	806,585	1906	1,060,390
1879 [b]	284,141	1893	526,951	1907	1,229,168
1880	493,408	1894	167,307	1908	776,898
1881	782,887	1895	524,153	1909	1,694,957
1882	589,655	1896	682,806	1910	2,591,031
1883	490,875	1897	489,970	1911	1,811,732
1884	487,820	1898	187,208		

[a] Fiscal years end.

[b] Calendar years begin.

EXPORTS.

The quantity of iron ore exported from the United States in 1911 amounted to 768,386 long tons, an increase of about 3 per cent over iron-ore exports in 1910. The exports were valued at $2,653,448, or $3.45 per ton, in 1911.

In the following table is shown the exportation of iron ore from the United States, by customs districts, from 1908 to 1911, inclusive. The data regarding exports are furnished by the Bureau of Statistics, Department of Commerce and Labor.

Quantity and value of iron ore exported from the United States in the calendar years 1908–1911, by customs districts, in long tons.

Customs district.	1908		1909		1910		1911	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
New York							10	$68
Savannah					10	$75		
Norfolk and Portsmouth			3	$27			37	357
Saluria							4,175	9,412
Buffalo Creek	25	$140	336	1,506	1,203	6,054	2,115	10,575
Champlain	7,359	22,517	9,417	27,170	19,941	71,740	13,583	49,278
Detroit	4	46						
Duluth	52,509	187,059	129,231	471,088	187,042	650,654	75,232	265,360
Niagara	3,097	7,289	6,887	21,819	2,848	12,956	369	1,550
Superior	244,408	789,306	306,270	830,415	519,396	1,683,824	657,895	2,286,908
Vermont	1,697	6,567						
Puget Sound			3,790	13,300	18,435	48,861	14,970	29,940
Total	309,099	1,012,924	455,934	1,365,325	748,875	2,474,164	768,386	2,653,448

The quantity of iron ore exported from the United States, so far as recorded, is shown in the following table:

Exports of iron ore from the United States, 1899–1911, in long tons.

Year.	Quantity.	Year.	Quantity.
1899	40,665	1906	265,240
1900	51,460	1907	278,608
1901	64,703	1908	309,099
1902	88,445	1909	455,934
1903	80,611	1910	748,875
1904	213,865	1911	768,386
1905	208,017		

IRON-ORE INDUSTRY OF CUBA.

The iron ores which were mined in Cuba prior to 1910 consisted largely of hematite and magnetite and were obtained near Santiago, in the Province of Oriente (Santiago). Recently large deposits of brown ore have been attracting considerable attention, especially those of the Mayari and the Moa fields, in Oriente Province, and those of the Cubitas field, in Camaguey Province. The brown ore shipped, 307,700 tons in 1910 and 387,791 tons in 1911, was from the Mayari field, in Oriente. Several interesting papers were published by the American Institute of Mining Engineers on Cuban iron ores in 1911, and these are listed in the bibliography at the end of this chapter.

The following table shows the shipments of iron ore from Cuba since the opening of the mines in 1884. The statistics of the Cuban iron-ore shipments were collected by the United States Geological Survey.

Shipments of iron ore from mines in the Province of Oriente (Santiago), Cuba, 1884–1911, in long tons.

Year.	Juragua Iron Co. (Ltd.).	Sigua Iron Co.	Spanish-American Iron Co.	Cuban Steel Ore Co.	Ponupo Manganese Co.	Total.
1884	25,295					25,295
1885	80,716					80,716
1886	112,074					112,074
1887	94,240					94,240
1888	206,061					206,061
1889	260,291					260,291
1890	363,842					363,842
1891	264,262					264,262
1892	335,236	6,418				341,654
1893	337,155	14,020				351,175
1894	156,826					156,826
1895	307,503		74,991			382,494
1896	298,885		114,110			412,995
1897	[a] 248,256		[b] 206,029			454,285
1898	83,696		84,643			168,339
1899	161,783		215,406			377,189
1900	154,871		292,001			446,872
1901	199,764		[c] 334,833	17,651		552,248
1902	221,039		455,105	23,590		699,734
1903	155,898		467,723			623,621
1904	31,162		356,111			387,273
1905	139,828		421,331			561,159
1906	133,379		507,195			640,574
1907	181,063		500,330			681,393
1908	366,580		452,854			819,434
1909	356,659		514,066		59,721	930,446
1910	318,814		978,676		165,008	1,462,498
1911	355,132		640,508		168,074	1,163,714

[a] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia.

[b] Of this quantity, 51,537 tons were sent to foreign ports.

[c] Of this quantity, 12,691 tons were sent to foreign ports.

PRODUCTION OF IRON ORE IN PRINCIPAL COUNTRIES.

The latest available statistics covering the output of iron ore in the principal producing countries are shown in the following table. Of the figures in this table, those for the United States, Great Britain, Cuba, Canada, India, and Australia are in long tons; those for the other countries are in metric tons.

Production of iron ore in principal countries in 1908, 1909, and 1910.

Country.	1908	1909	1910
	Tons.	*Tons.*	*Tons.*
Algeria	943,424	891,000	(a)
Australia	55,194	48,636	(a)
Austria-Hungary	4,718,700	4,575,828	(a)
Belgium	188,780	199,710	122,960
Canada	b 212,573	b 239,324	b 231,623
China	c 133,458	c 89,108	(a)
Cuba	d 819,434	d 930,446	d 1,4[illegible]2,498
France	10,057,145	11,890,000	(a)
Germany and Luxemburg	24,278,151	25,504,464	(a)
Greece	531,368	475,616	(a)
India	72,300	83,456	(a)
Italy	539,120	505,095	(a)
Japan e	(a)	(a)	(a)
Newfoundland	935,154	1,004,050	(a)
Norway	119,656	40,389	(a)
Russia f	(a)	(a)	(a)
Spain	9,271,592	8,786,021	(a)
Sweden	4,713,160	3,886,000	(a)
Tunis	148,000	218,000	(a)
United Kingdom	15,031,025	14,804,[illegible]	15,226,015
United States	35,924,771	51,155,437	56,889,734

[a] Not yet available.
[b] Shipments. During 1911 Canada shipped 187,807 long tons of iron ore.
[c] Exports.
[d] Shipments.
[e] Japan produced 45,396 metric tons of pig iron in 1908, and 54,191 tons in 1909.
[f] Russia produced 2,824,474 metric tons of pig iron in 1908, and 2,622,419 tons in 1909.

PROSPECTING FOR IRON ORE.

GENERAL STATEMENT.

The United States Geological Survey has received many inquiries in the last few years with regard to methods of prospecting for iron ore, and in order to supply some information on this subject, outlines on prospecting for certain types of ore, such as hematite and limonite, are given below. Owing to the variety of ores and to the differences in local conditions of climate, topography, geologic associations, and structure, any set of suggestions can at best be only very general, but it is hoped that a few of the fundamental principles at least may be made clear.

Referring to page 8 for varieties of ores, it will be noted that hematite is the most common commercial ore of iron, followed in order by brown ore, or limonite, magnetite, and iron carbonate.

PROSPECTING BY PITS AND DRILLS.

BEDDED HEMATITE.

The simplest form in which hematite occurs is in horizontal or gently inclined beds or lenses, such as are characteristic of the Clinton ore in west-central New York and in the Appalachian region of

Pennsylvania, Virginia, Tennessee, Georgia, and Alabama, also in Kentucky and Wisconsin. These beds range in thickness from a few inches to 10 or 12 feet, and in rare instances to 35 feet, and generally their outcrop may be found at intervals for many miles, if the associated formation, which consists mainly of shale, sandstone, and limestone, be followed. In places, especially in the southern Appalachians, the formation carrying the Clinton ore has been badly folded and broken by faults. In such situations the ore beds are generally steeply inclined and their edges have a very definite strike along the surface.

The first step in prospecting for bedded hematite is to determine, in places where the ore is known to be present, its approximate distance below the top of the inclosing formation. Naturally this will vary with the thickness of the whole formation. In the southern Appalachians the black Chattanooga shale overlies the Clinton formation. In Alabama the ore beds lie usually from 80 to 175 feet below the black shale, and in Tennessee the main ore bed lies generally from 60 to 200 feet below the black shale. Persons who are familiar with the Clinton ore and formation locally should be able to recognize the ore-bearing zone within narrow limits by means of some associated bed, such as a heavy sandstone, a crystalline limestone, a red shale, etc. In prospecting trenches or pits are dug at right angles to the strike of the formation, sufficiently deep to reach solid rock and wide enough for a man to stand in. In the southern Appalachians,
where there is no glacial de
considerable depths, but o
crop erosion has removed t
ering has advanced, so tha
than 5 feet deep, and gene
depths. Where a bed of t
erally "soft;" that is, lea
may be so badly disintegra
is not apparent, and, furt
between the loosened grain
unless it is firm and unalte
slope, or tunnel far enough
if possible, and it is very
should be reached, as sam
indication of the ultimate c
series of pits extending to t
the extent of the soft ore i
the soft and hard ores, the
as the angle and direction
reckoned with in consider
mining.

The foregoing notes appl
In developing Clinton iron
to determine whether the
character below the surfac
dip changes; whether fau
may be lost. Core drilling
from the outcrop has yield
mingham district, and sho

district and farther north. The importance of efficient drilling apparatus, of thorough and intelligent supervision of work, and of careful, accurate recording of drill logs can not be urged too strongly here. Unfortunately much money has in the past been wasted by ill-considered methods of drilling. Attempts have been made to drill deep holes with apparatus that was inadequate, and such holes have been mostly abandoned, without reaching ore. Holes have been drilled with the churn drill, which as the best yields very uncertain results. A core is absolutely necessary, if the true thickness, quality, and dip of the ore are to be determined. Many holes have been drilled, with both the churn drill and the core drill, the logs of which are preserved only in the memory of the driller, and the washings and cores from the ore beds were scattered to the winds without securing material for chemical analyses. The rocks above the Clinton ore consist of sandstone, limestone, cherty limestone and chert, and shale. All of these rocks except the shale are hard to drill. Both the diamond-bitted drill and the steel bit with crushed steel are proving successful in bringing up cores. The cores most satisfactory are those with diameters not less than 1¼ inches. Costs of drilling in the Appalachian Valley rocks range from $3 to $5 per foot, depending on the diameter of the core and the depth of the hole. A discussion of core drilling as applied to the Birmingham district has been given in an earlier Survey publication.[1]

LIMONITE, OR BROWN ORE.

Under the head of brown ore are deposits of several different types. Probably the most common brown ores are (*a*) the residual and (*b*) the replacement ores of the mountain and valley regions from New England southwest through the Appalachians to Alabama and occurring to some extent in the Mississippi Valley. The residual ores occur in irregular masses, bowlders, pebbles, and sand, and as cementing material in beds of conglomerate. The masses and bowlders are usually imbedded in clay that is residual from limestone and lies on an uneven surface of limestone or dolomite. The ferruginous conglomerate overlies the irregular masses of brown ore and clay, and the gravelly and sandy ore forms a thin mantle in places over the lower deposits. The residual brown ores are in most places covered by sand, gravel, and soil, and in many places the surface is timbered. At the surface ledges of ore appear in places, especially in gullies, and ore gravel is often noted, but owing to the cover of barren material that is commonly present prospecting must be done in order to establish the presence of ore, its thickness, extent, and quality, and the thickness of the overburden. One common method of prospecting is by test wells sunk by hand, and the churn drill is also employed. Test wells as sunk in Alabama and Georgia are 30 to 36 inches in diameter, and if sunk in unconsolidated materials may reach depths of 50 feet. The cost of such pits should range from 35 to 50 cents a foot. If limestone is reached in a test well there is no need to sink it deeper, for no ore will be found, but if ore is reached it is of importance that the well should be sunk through the deposit, and this may be more difficult and costly work, especially if the ore is very hard.

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[1] Burchard, E. F., The iron ores of the Birmingham district, Alabama; Bull. U. S. Geol. Survey No. 400, 1910, pp. 141-142.

Examples of tracts prospected by test wells and of the associated brown ore mines are described in a former Survey bulletin.[1] According to Geismer [2] the tools needed in sinking test wells by hand are a windlass, rope, bucket, and short-handled pick. Such holes, of about 30 inches diameter, can be sunk economically to depths not exceeding 30 feet, providing but little solid material is encountered. When rock is encountered blasting is necessary, and the small diameter of such holes does not permit a steel and hammer to be used to good effect, but if their diameter be increased the test wells become too expensive. In ordinary unconsolidated material two men will sink about 10 feet a day.

Geismer, in the paper cited, gives a practical discussion of churn drilling, from which the following passages are quoted:

> *Boring with churn drills.*—In churn drilling, the property is covered with holes of about 6 inches diameter, to any required depths up to 500 or 600 feet. The holes are drilled rapidly, a good crew averaging about 50 feet per shift when in loose material, and 30 feet in rock, and the cost is less than by any other method. Any of the light types of standard churn drills are suitable, and either steam or gasolene power may be used. If the country is rather hilly, and water has to be hauled from a distance, the gasolene machine is to be preferred, as it is lighter and requires no water for boiler use; two or three barrels of water per shift will furnish such a machine with all that is required for cooling the engine, following the bit, and floating the drillings for the sand pump.
>
> For general prospecting I prefer a light, nontraction, gasolene-driven machine, weighing about 6,000 pounds, exclusive of the gasolene engine. The holes required for brown-ore prospecting rarely exceed 150 feet depth and, as a rule, do not require casing, so that the lightest machine will stand up to the work. Unless the ground is level, the traction feature is of little advantage. For such machines a 6-horsepower engine is ample. In purchasing such machines it is advisable to get extra bits, as broken and loose bits often delay the work for days when no extra ones are at hand.
>
> *Precaution in churn drilling.*—In using churn drills two precautions must be insisted on continually, or the results will be useless if not misleading.
>
> (1) Bail the hole out clean with the sand pump every time the drill advances 3 feet.
> (2) Carefully examine the washings recovered by the sand pump for quantity and quality of ore contained.
>
> If a bit is penetrating clay strata and suddenly encounters an ore bowlder, the first result will be to force the bowlder down into the soft clay that underlies it; gradually as this clay becomes more and more compact the bowlder will begin to crack, and finally the bit will force its way completely through it. Unless, therefore, the hole is carefully bailed at frequent intervals, the sample recovered at any particular depth may not represent the material being penetrated at that time, and it might be possible to recover the ore in the sand pump for some time after the actual ore deposit had been completely penetrated. Careful bailing of the hole after each 3 feet of drill advance will eliminate this chance of error and give accurate results.
>
> In instructing drill operators for this class of work it is advisable to follow down the first few holes with wells, so that the driller may examine the strata foot by foot, and see exactly how they compare with what the drill led him to believe would be found. Similar test wells are also to be advised whenever the nature of the deposit changes considerably.
>
> *Examination of the borings.*—The quantity and quality of the ore encountered by the drill, and the thickness of the ore deposit are determined as follows: Each time the bit advances 3 feet the hole is bailed out with the sand pump, and from the washings recovered by the pump a pailful is saved. This pailful is carefully sifted until all of the mud is separated from the rock (ore, etc.), and the rock material is then put into bags and sent to the laboratory to be analyzed. From these samples one can obtain a general idea of the quality of the ore that may be recovered from the deposit, provided certain allowances are made: If the washings contain much clay, the sample will be better than the ore mined, because no washer will make a complete separation of clay and ore; if the washings show considerable worthless rock or sand mixed with the ore, the sample will not be so good as the final product, because by means of jigs

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[1] Burchard, E. F., The iron ores of the Birmingham district, Alabama: Bull. U. S. Geol. Survey No. 400, 1910, pp. 161–165.

[2] Geismer, H. S., Prospecting for brown iron ores: Eng. and Min. Jour., Sept. 9, 1911, pp. 498–500.

and picking belts the larger part of the rock and sand can be separated. Just how accurately the observer can allow for these characteristics will depend upon his experience.

As soon as the samples indicate that the lower limit of the ore has been reached, drilling is stopped and the exact depth of the hole is measured and recorded.

The relative quantity of ore per foot of depth is estimated by the amount of ore recovered from the bucketful of washings, and by occasional test wells following the drill holes. Such results may appear manifestly inaccurate to one who has never had experience with such prospecting, but an experienced observer will obtain results that are as accurate as any of the factors that enter into an estimate of brown-ore tonnage.

The value of a detailed topographic map in connection with the prospecting of brown ore, as well as in later development work, can not be overestimated. On such a map may be plotted the positions of all test wells or drill holes, and the productive areas may be shaded or colored. The contours will show the relative altitude of the top of each prospect, so that profile sections can easily be drawn to show the vertical range of the ores and their relation to the drainage. By means of such a map it is much easier to select the best sites for a storage dam, pump house, washers, and settling pond, and to lay out mine openings, railway and tram tracks, pipe lines, etc. A convenient scale for such a map is 100 feet to 1 inch, with 5 to 10 foot contour intervals. A large supply of water is essential to brown-ore mining, and it is therefore as necessary to make sure of the water supply as of the ore supply in prospecting.

PROSPECTING BY MAGNETIC SURVEYS AND DRILLS.

LAKE SUPERIOR ORES.

EXPLORATION BY MAGNETIC SURVEY.

The Lake Superior iron ores are (1) soft brown or red slaty hydrated hematites; (2) soft limonite; (3) hard massive and specular hematites; (4) magnetite; and (5) various gradations between the other classes. About 93 per cent of the shipments is composed of soft hematite from the Mesabi district, Minnesota, and hard hematite from Ely, Minn., and the Gogebic district, Michigan, and about 7 per cent consists of hard hematite, specular hematite, and magnetite from the Marquette district, Michigan.[1]

The Lake Superior iron ore districts lie within the region of glacial drift. Over certain of the districts, such as the Marquette, the eastern Menominee, the Gogebic, and parts of the Vermilion and the Mesabi, the clay, sand, and gravel deposits, which constitute the major portion of the drift, are relatively thin and the hard rock outcrops are abundant. Over the Crystal Falls, Iron River, and Cuyuna districts the drift is thicker and outcrops are either very few or are entirely wanting. Under such conditions the traverses ordinarily made in constructing a geologic map or in tracing the outcrop of an ore bed are of little service, and methods of surveying dependent on the magnetism of certain of the buried rocks have been developed. The great bulk of the ores are not magnetic to a noticeable degree, but certain of the iron-bearing rocks possess sufficient magnetism to affect the magnetic needle. The iron-ore bodies in the Lake Superior districts are found in a wide variety of shapes. They may be roughly tabular in a horizontal plane, as in the Mesabi district, or roughly tabular in steeply inclined planes or in steeply pitching linear shoots, as in the Menominee district, or they may occur in almost any combination of these shapes. Structural conditions have mainly determined the location of ores within a given area of the iron formation. Impervious basements for ore bodies are formed in the Gogebic district by the intersection of the footwall quartzite with an igneous dike; in the Marquette district by irregular intrusive masses of basic rock and by slate; in the Menominee district by dolomite; in the Crystal Falls, Iron River, and Florence districts by slate; in the Gogebic and Mesabi districts by interbedded slate layers, and locally in the Mesabi district by granite. Most of the impervious basements in which the ores have been localized are in the form of pitching troughs. The ores are also found in fractured zones in the iron-bearing formation and in the neighborhood of faults that have intersected the impervious basement, both of these structures being favorable to the passage of altering solutions.

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[1] Van Hise, C. R., and Leith, C. K., The geology of the Lake Superior region: Mon. U. S. Geol. Survey, vol. 52, 1911, pp. 479 et seq.

Van Hise[1] and his associates give the following discussion with regard to the magnetism of the Lake Superior iron ores and iron-bearing formation:

> *Magnetism of the Lake Superior iron ores and iron-bearing formations.*—All ores of iron are found to be magnetic when tested by sufficiently delicate means. Ordinarily magnetite is the only iron mineral which causes conspicuous disturbance of the magnetic needle. Practically all the Lake Superior iron-bearing formations contain at least minute quantities of magnetite, and hence all exert an influence on the magnetic needle, but in widely varying degree. The iron-bearing formation of the Vermilion district and other Keewatin areas is strongly magnetic. The same is true of the formation in the east end of the Mesabi district, the Gunflint district, the Cuyuna district, and the east and west ends of the Gogebic district, and of most of the Negaunee formation of the Marquette district. Less magnetic parts of the iron-bearing formations are those producing principally hematite and limonite, as the central and western parts of the Mesabi, the central part of the Gogebic, and parts of the Menominee and Crystal Falls districts. The iron-bearing member of the Iron River district of Michigan affects the magnetic needle only locally and slightly.
>
> Every known iron-bearing formation in the Lake Superior region, with the exception of that in the extreme west end of the Mesabi district, has been outlined partly as a result of magnetic surveys. In some of the districts, as, for instance, the Iron River district, the magnetic variation is slight, but careful observations will detect it. In addition, several magnetic belts are known in which exploration has not yet shown the character of the iron-bearing formation. * * *
>
> Strong magnetic disturbance does not necessarily mean ore, and, vice versa, ore does not necessarily cause strong magnetic disturbance. Lean amphibolitic schists may be highly magnetic, while rich hydrated soft ore has but little effect on the needle. Although magnetic disturbance is usually caused by an iron-bearing formation, it is also caused by certain basic igneous rocks, like the ellipsoidal basalts of the Keewatin or gabbro intrusives. There is little difficulty in ascertaining the cause of the attraction, however, for somewhere along most of the magnetic belts in the Lake Superior region there are outcrops which indicate the nature of the rock causing the disturbance. If the rock is entirely covered, it may still be possible to determine whether the disturbance means iron-bearing formation or some other rocks. The iron-bearing formations are sedimentary deposits with certain linear characteristics of distribution, giving even lines or "belts" of magnetic attraction, whereas the basic igneous rocks are likely to cause a much more irregular magnetic field. * * *
>
> Although the iron ores may not be discriminated by means of the magnetic disturbances, it is possible under some conditions to draw useful inferences from them as to the dip or folding of a buried iron-bearing formation. A sharp, narrow belt of magnetic attraction leading up to a definite maximum usually means a highly tilted formation presenting a narrow erosion edge at the rock surface, as in the Gogebic or

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[1] Van Hise, C. R., and Leith, C. K., op. cit., pp. 486–488.

the Vermilion district. A wide, more irregular, and less well-defined belt of attraction is ordinarily associated with a flatter dip, exposing a greater area of iron-bearing formation to the erosion surface. The producing part of the iron-bearing Biwabik formation of the Mesabi district illustrates this. Unequal magnetic gradient on two sides of a maximum may indicate the direction of dip of the iron-bearing beds. The outward dip of the iron-bearing formation about the Archean ovals of the Crystal Falls district is so indicated. Several roughly parallel, more or less discontinuous magnetic belts, here and there converging and joining, may indicate repeated pitching folds, as in the Cuyuna district.

General laws of interpretation of magnetic attraction require much local modification. It is usually necessary to ascertain for each locality the magnetic character of the iron-bearing formation, to correlate this with known facts from outcrops or underground workings, and from the knowledge thus obtained to interpret the results of the magnetic formations in covered parts of the area where the magnetic readings alone are available. H. L. Smyth.[1] in connection with much magnetic field work in the Lake Superior region, has developed mathematical relations between magnetic fields and various attitudes of the rock beds which may serve as a useful guide in detailed surveys.

The instruments which have been used in Lake Superior magnetic surveys are the dip needle and the dial compass. The dip needle determines the vertical component of the magnetic pull, as well as the direction of the horizontal pull; the dial compass determines only the direction of the horizontal pull. Methods of using and interpreting these instruments are discussed in detail by Smyth. The dial compass is essential in most of the work because it affords means of keeping accurate directions necessary for location and of reading the horizontal component of the magnetic variation. It may be used only on sunny days, and thus magnetic work in the Lake Superior region is likely to be slow and expensive. The dip needle may be used at any time, but in a disturbed field it affords no means of keeping horizontal directions, and hence location. This is an essential defect in country in which the roads and other works of man afford little aid in keeping location.

In theory the use of the magnetic needle is simple, but much practice is required to insure uniformly accurate observations. The unskilled observer finds many pitfalls in the mechanism of the instrument, in the manner of holding it, in the effects of temperature, in electrification from rubbing the glass, etc. There is much opportunity for the exercise of good judgment in the determination of the intervals at which readings shall be taken, the direction and number of runs, etc. These should be varied for different areas, depending on the structure found or suspected. Finally, the interpretation of the results calls for consideration and careful balancing of a great variety of factors, capacity for which is acquired only by wide experience and painstaking observation. * * *

A very interesting and practical discussion of exploration and prospecting for iron ore and of the magnetism of rocks and the use of the needle in exploration was published by Maj. T. B. Brooks[2] in 1873 and is still a standard for reference. The discussion of prospecting covers such points as: Prospecting and woodcraft; organization of party; supplies; equipment; maps; mode of working; how to recognize iron ore; digging for ore; sinking, drifting, trenching, drilling; quality and quantity of ore; average sample and how to get it; approximate analyses in the woods. The discussion of magnetism touches among other things on magnetism of rocks and use of the needle; elementary principles of magnetism; magnetic instruments; dip compass and its use; solar compass; Ritchie's compass; Amsden's compass; geologic sketch of the magnetic rocks; loadstones; magnetic rocks are not ores; origin of ores; explanation of magnetic chart, plans, and sections; practical suggestions and rules; what can and what can not be determined by the needle.

A practical discussion of the methods of magnetic surveying with sundial and dip needle as used for prospecting deep-seated iron ore deposits in the Lake Superior region was published about one year ago by Archibald,[1] from which the following extracts are quoted:

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[1] Smyth, H. L., Magnetic observations in geological mapping: Mon. U. S. Geol. Survey, vol. 36, 1899, pp. 336–373.

[2] Geol. Survey Michigan, vol. 1, 1873, pp. 187–244.

> *Instruments for magnetic surveying.*—The usual instruments used in this region for magnetic work are the sundial compass and the dip needle. These instruments are both of prime importance, although much of the work has been done with the dip needle alone.
>
> The sundial compass is an instrument that was invented by Burt for land surveying in districts of magnetic attraction. The common type consists of a 3-inch magnetic needle mounted in a circular box around the upper outside edge of which is placed the hour circle graduated for the latitude in which the observations are to be taken. Different gradations are furnished by the maker for each one-half degree variation in latitude. In the line of the meridian, or in the positions of noon and 6 p. m., are mounted vertical sight standards. A silk or linen thread is attached to the standard placed in the position of noon and is stretched across the dial in the plane of the meridian. This string, called the gnomon, makes an angle with the horizontal equal to the latitude. The standard should have different points for attachment so that the inclination of the string can be varied to agree within a half degree with the latitude of the place where the observations are made. The usual method of doing this is by having holes punched at different heights on the standards marked with the corresponding latitudes. A more desirable form would be a vertical standard with a variable adjustment which could be made to slide up and down the standard by means of an adjusting screw and which would carry the hole through which the thread could be made fast. The instrument as a rule is provided with level bubbles and is made to set up on a single vertical stick or Jacob's staff.
>
> The method of operating the sundial is as follows: When the instrument is set up with the standards in a north-south plane, the shadow cast by the gnomon on the dial will indicate the correct apparent solar time. Therefore, in order to obtain a true north line it is only necessary to orientate the instrument so that the shadow indicates this time. In order to get correct apparent solar time from standard time two corrections are necessary; to subtract or add the difference in time corresponding to the number of degrees west or east of the standard meridian at which the observation is taken. This will give mean solar time, to which time must be added or subtracted a correction, the equation of time from solar ephemeris for the day, month, and year of the observation. Example: Longitude of place of observation equals 88½ degrees; date of observation, November 1, 1908; standard 90th meridian time, 12 noon; one hour in time equals 15 degrees; 90−88½ is equal to 1½ degrees; 1½ degrees of longitude equals 6 minutes time; therefore, mean solar time equals 12.06 p. m.; equation of time to be added for November 1, 1908, taken from solar ephemeris, equals 16 minutes, 19 seconds; therefore, apparent solar time is equal to 12 hours, 22 minutes, 19 seconds; therefore, if the shadow of the gnomon is placed at 22 minutes and 19 seconds past 12 the sight standards will be in a true north-south plane.
>
> The errors to which observations with this instrument are liable are due, first, to the use of an instrument whose hour circle is not graduated for the latitude of the place of observation; second, errors due to poor watches and incorrect calculations of time; and third, errors due to the fact that the gnomon is not adjusted on the instrument to the angle of the latitude.
>
> In regard to the second error it is suggested that when a new camp is pitched and the watches are correct it is well to set up the instrument and place two stakes accurately on the north-south line, then each morning before taking the instrument into the field the watches can be set by orientating the instrument on the stakes and observing the shadow on the dial. This gives a handy method of correcting the watches each day and insures accurate time.
>
> The third error is a much more serious one. It is due to imperfections in the manufacture of the instrument. The vertical standards are made so that they fold when packed. The hinges on these standards are so imperfect that it is difficult to be sure that the standard to which the gnomon is attached is truly vertical when raised. In case it is not, the angle that the string makes with the horizontal will not be equal to the angle of the latitude and a serious error will be introduced. To overcome this error the observer should make a triangle of cardboard with one angle equal to the latitude. The angle of the gnomon can then be tested at any time in the field with this triangle. In case the instrument were made with a screw adjustment this error could be corrected at any time.
>
> *Surveying with the sundial compass.*—In making the observations with a sundial compass it is customary to run north-south or east-west lines from the Government subdi-

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[1] Archibald, R. S., Magnetic surveys of iron deposits; Eng. and Min. Jour., June 10, 1911, pp. 1157-1160.

vision points. These lines are run as close together as the character of the work justifies. The usual practice is to run them not more than one-eighth of a mile apart, that is, one between every sixteenth post. The normal magnetic variation is set off on the instrument by means of a vernier provided on the compass. At regular intervals, say at 100 paces or less on these north-south or east-west lines, the instrument is set up and orientated and the magnetic variation is recorded. In connection with the reading of the horizontal needle at these stations, dip-needle readings are taken, as will be explained later. It is also customary to make a detailed geologic study of the country passed over at the same time, outcrops being located with reference to the line run with the compass. When in a magnetic country the strike of the rocks should be taken by means of the sundial also. Trained woodsmen are employed to run the compass and the limit of error of 1 in 100 or 20 paces to the mile is common in this class of work.

The dip needle is an instrument used to observe the vertical component of a magnetic field. There are two types in general use: The Norwegian needle, in which the magnet is pivoted on a universal joint so that it assumes the direction of the magnetic field; and the other type in which it is fixed rigidly in one plane, which permits of only a vertical deflection. The fixed-needle instrument is found to work much more satisfactorily than the Norwegian needle, because it is more sensitive and the bearings do not get out of order so quickly. In using, the observer must orientate it into the plane of the horizontal needle at the station of observation. The needle of the dip needle is weighted on the south end with a piece of wire to overcome the moment of the normal magnetic field. This wire can be adjusted so that the needle will read zero in a region of no local attraction. However, it is difficult to keep the needle at this adjustment so that it is more practical to record a constant error. In the rough field work incident to magnetic observations the bearings of the dip needle are apt to be injured. Constant care and attention are necessary to insure accurate reading with this instrument. It is good practice to have two or more needles in the same party. Frequent comparisons of readings over the same station will indicate whether they are working accurately. The writer has had occasion to use as many as three different needles during the same season's field work. The novice with this instrument is very apt to get a set of observations of absolutely no value.

Recording magnetic work.—The easiest method of mapping and recording magnetic work is on square cross-section paper 20 inches wide ruled with 10 divisions per inch. The work is usually mapped by sections and the outcrop plotted on the same map. A convenient scale with the cross-section paper is 20 inches, equal to 1 mile. In the field the trained woodsman is accustomed to pace 20 tallies, or 2,000 paces, to the mile. In case his natural stride does not agree with this length of pace he corrects it at the end of each tally. On the above scale 1 tally is equal to 1 inch, and one small division on the paper, or one-tenth inch, equals 10 paces.

The readings of the horizontal needle are entered on the map at the stations where they are observed, with an arrow indicating whether they are east or west of north. The dip-needle readings are plotted in the form of a curve from the north-south or east-west line of that traversed as a base and each degree of dip is plotted equal to one small division of the cross-section paper. When completed the map is in such shape as to permit making deductions as to location and structure of magnetic rocks as well as geological inferences from outcrops. In working with these maps a special scale can be purchased divided with 1 inch equal to 264 feet, so that distances can be scaled directly from the map.

In the field a convenient notebook is the engineer's cross-section notebook, 6½ by 8½ inches in size, with rulings of cross-section paper the same as has been described. Each page of the book is large enough to cover five large squares each way, and therefore will include a 40-acre tract with sufficient room at the bottom of the page for geological notes and specimen numbers. A convenient arrangement of the notes is to use the first two pages on the right and left hand sides of the open book as the northeast quarter of the northeast quarter and the northwest quarter of the northwest quarter, respectively. The next two pages, the southeast quarter of the northeast quarter and the southwest quarter of the northeast quarter, and so on through the other quarters of the section. This is a simple and logical arrangement of the notebook.

Interpretations of magnetic readings.—It is not the purpose of this paper to go into a mathematical discussion of the theory of the effects of the magnetic disturbance upon a horizontal and a vertical needle. However, an attempt will be made to give a practical discussion of the phenomena and rules to guide in the proper interpretation of them. This discussion is condensed from Monograph 36[1] of the United States Geological Survey on the Crystal Falls iron-bearing district.

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[1] Smyth, H. L., op. cit.

As has been indicated, the formations to be explored are either sedimentary or a more or less regular contact of sediments with intrusives. This results in the localization of the magnetism in the form of long narrow bands more or less steeply inclined.

The magnetism in these bands is due to induction by the earth's field. Therefore, negative or south pole polarity is uniformly found at the outcrop, while the north pole, considering the rocks as magnets, is located at an indefinite distance below the surface out of reach of influence upon the compass or dip needle. A magnetic formation can, therefore, be considered as a solid sheet magnet with the south pole uppermost. In magnetic work the lines are run north and south or east and west, whichever direction cuts the formation at the greatest angle.

The vertical and horizontal components of the magnetism in rock strata combined with the vertical and horizontal components of the earth's magnetic field determine the resultant forces acting on the vertical and horizontal needles. The earth's magnetism is approximately constant.

The magnetic force of a given magnetic band varies inversely with the square of the distance of the instrument from the seat of the magnetism in the band. In general, this force is dependent upon the thickness of the overburden and the distance of the instrument from the formation.

In discussing the phenomena observed in the readings of the horizontal and vertical needles, the following cases will be discussed: (1) Magnetic formation with vertical dip; (2) magnetic formation dipping at any angle and with strike inclined at any angle to the north; (3) the special case of the magnetic rocks striking due east; (4) parallel magnetic formations.

Zones of magnetism at contacts.—Any method of tracing the surface contours of the footwall or, in fact, any contour of any sedimentary bed intimately associated with the ore, will be of great importance in locating structural troughs where the ore is likely to be found. In the case of deposits formed by the intersection of intrusives, any method that will locate the exact position of the contact between the iron ore and the intrusive will be of use in determining where to drill for these ore bodies.

* * *

The majority of the ore bodies themselves and also the inclosing rocks unaltered by the effects of metamorphism by igneous intrusion are nonmagnetic, but fortunately for the magnetic prospector it often happens, especially in the Crystal Falls, Iron River, and Cuyuna districts that there is found magnetic slate intimately associated with the ore. The tracing of the location and strike of this slate gives an indication of the situation of the ore and also of structural troughs. In the case of ore bodies formed by intersecting dikes it has been found in many instances that the contact of the dikes and iron formation was magnetic. Thus it is possible by magnetic means to map these contacts.

Vertical magnetic formation.—Let us consider under this head a magnetic formation with a vertical dip, a width of 2 A, and a depth to cover equal to H. In approaching such a formation from the east, on an east-west traverse, the horizontal needle will first show a westward deflection, increasing with the approach to the formation and reaching a maximum near the east edge of the belt. It will then begin to decrease and reach zero in the center of the belt, increasing with an eastward deflection to an east maximum near the west edge of the formation and thence decreasing to normal, outside of the reach of the magnetic formation. If X represents the distance of the maximum points from the center of the formation, it can be shown that: $X^2=H^2+A^2$. The relative amount of deflection at the east and west maxima will depend upon the direction of the strike of the rocks. When the strike is north these two maxima will be equal. When it strikes east of north the western maximum is the greater. When striking west of north the reverse is the case.

With an east-west traverse approaching the formation from the east the vertical needle will start with a constant error outside of the range of magnetic influence of the rock and increase gradually through a maximum at a point within the formation; passing westward it will again decrease to zero. The point of maximum deflection in a formation with a north strike will be in the center. With a formation the strike of which is inclined at an angle to the north, the maximum deflection will be reached at a point that lies on the side of the formation making an obtuse angle with the east-west traverse.

As in the case of the horizontal needle, it is also found with the dip needle that the dip curve, or curve representing the respective readings of the dip needle, will not be symmetrical in approaching a formation with other than a north strike. When the formation strikes east of north, the western dips are greater or the dip curve will be steeper on the east side, or, generally speaking, stations on the side of the formation on which the east-west line of traverse make an obtuse angle show the greater dips. These conclusions are only true for vertical formations.

Magnetic formation of any dip.—In formations dipping at moderate to low angles the assumption that the north pole of magnetism is out of reach of the needles is not warranted. The influence of the bottom pole is to decrease the force acting upon the needle at any point. The following general conclusions can be demonstrated mathematically and have been observed in the field with regard to behavior of the vertical and horizontal needles under these conditions of dip of formation: (1) The direction of dip of the magnetic formation is toward the nearer of the two maxima to the point of zero horizontal deflection. (2) The point of no deflection of the horizontal needle is not over the center of formation but lies nearer the dip side. (3) In rocks with slight dips the horizontal maxima are not so pronounced, and irregularities in the behavior of the needle are observed. (4) The dip needle shows a maximum value near the zero of the horizontal needle only where the rocks are steeply inclined. In case of flat dipping rocks the vertical needle is apt to show, on the side opposite the dip side, a wide zone of readings which are less than normal.

Magnetic rocks striking due east.—The prevailing strike of a large number of iron-bearing rocks of the Lake Superior region is east, so that the special case of the behavior of the vertical and the horizontal needle with such rocks is of importance.

In prospecting such a formation the traverse should be run north and south. In approaching the belt from the south it will be readily seen that the horizontal needle will give but little indication of its presence, inasmuch as the magnetism of the rocks acts in the same direction as that of the earth; therefore no southern maximum will be observed. After passing the magnetic belt the magnetism of the earth and the magnetism of the rocks will act in opposite direction, and when that of the rocks exceeds that of the earth the direction of the needle will be completely reversed, and the north end will point south. Farther north the earth's magnetism will counterbalance the local magnetism and the needle will again swing around into the meridian. It generally happens, however, especially when the rocks are not overlain by deep cover of drift, that the irregular distribution of the magnetism on their surface will produce other deflections than those described. They will be haphazard and will not indicate magnetic maxima.

The dip needle readings for an east striking formation with a considerable covering of drift is as follows: Starting with a reading of constant error at a considerable distance from the formation, in moving northward the readings increase slowly to a point north of the center of the formation, where they reach a maximum. Then they decrease until they reach a normal condition north of the influence of the magnetism of the rocks. The reading north of the maximum will uniformly show higher value than corresponding points to the south; that is, the dip curve has a steeper slope south of the maximum than north. It often happens that readings less than normal will be observed south of the magnetic belt. This is due to the fact that the rocks have a very small covering and the horizontal magnetic forces are so strong that they counteract the vertical component.

Parallel magnetic formations.—In the previous discussion only one belt of magnetism has been considered. It often happens that two belts of magnetic formation lie so close together that their magnetism combines to produce a different set of phenomena. This is the case where there are two distinct magnetic formations in the same series of rocks.

It more often happens that the same magnetic belt has been repeated by close folding or faulting or by intrusion of a narrow eruptive producing the phenomena of parallel formations. The proper interpretation of the phenomena is of importance in working out the structure of the rock and especially in the detection of synclinal folds where the presence of ore bodies is probable. Under this heading will be discussed, first, formations parallel and with a vertical dip; second, parallel formations dipping at equal angles in the same direction; third, parallel formations dipping toward each other, and, fourth, parallel formations dipping away from each other.

In formations with a vertical dip, or in fact with any parallel formations, the phenomena vary widely with the distance between the magnetic formations and with the depth of surface covering. In general it can be said that formations with a vertical dip will show three points of minimum horizontal readings with three corresponding maxima. One of the horizontal minima will be midway between two formations and the other will be at the outer edges of the magnetic belts. As the depth of cover increases the minima and maxima will grow less distinct and finally merge into one point of minimum deflection midway between the two formations and two maxima at the outer edges of the two belts. The vertical needle will show two points of maximum deflection opposite the center of each magnetic formation.

Formations dipping in the same and opposite directions.—In the case of formations both dipping in the same direction at the same angle, the horizontal needle will usually show three minima, one between the formation and the other two on the dip side of each belt. The vertical needle as a rule will show two maximum points of deflection, one on the dip side of each formation.

When the formations dip toward each other there is an infinite variety of phenomena, depending on the relative dips of each formation and the depth of cover. There will usually be indications of horizontal minimum values at three places with corresponding maxima. One of the minima will be between the two formations, the other two being on the dip side of each formation. The side of the two outside maxima indicate the steepness of the dips of the respective formation, the formation with the steeper angle of dip having the larger maximum. In the same way the vertical needle shows two maximum values, one over each formation, the greater maximum over the steeper. It will be readily seen that the above condition of dips of formation will arise from the structure of the syncline.

In the case of two formations dipping in opposite directions which will arise in the structure of an anticline, the distance apart of the two formations, i. e., how deeply the anticline has been truncated, is the determining factor in the character of the readings. When the legs are separated by considerable erosion the phenomena indicate two formations and their respective dips.

There is a central horizontal minimum between the formations and two minima on the dip side of each limb. The dip curve shows two maxima, one on the dip side of each formation. In case the formation has been but slightly eroded, i. e., the legs are close together, the phenomena will indicate one vertical magnetic belt.

The pitch of anticlinal and synclinal axes.—It is universally true, in the iron-bearing rocks of this district, that the axes of synclines and anticlines do not continue horizontally for any length of time, but pitch at more or less steeply-inclined angles. It is, therefore, found that the magnetic phenomena of parallel belts will not continue long in the direction of the strike in such a fold. In working toward the outcrop of the axis of the syncline the belts will come closer and closer together until finally the end of the formation is reached, beyond which magnetic phenomena disappear entirely. In working toward this outcrop it will also be found that the direction of the magnetic force of the rock will no longer act at right angles to the strike, but will be inclined in the direction of the pitch of the axis.

In working toward the pitch of an anticlinal axis the belts approach each other as the formation gets deeper and deeper. Finally they will join and continue as one magnetic belt which will grow weaker until finally the rocks are so deeply covered that their magnetic force will not influence the needles at all.

In the case of a formation split by an intrusive, the shape of the intrusive, i. e., the dips of the sides of the contact, will govern the character of the magnetic action. As we pass along the strike of such a formation we will finally come to a point where the intrusion pinches out. This will usually happen abruptly. The magnetic belt will then continue as one formation.

The above discussion may seem to the average user of sundial and dip needle as merely theoretical and the results described unattainable in practice, due to the many disturbing influences and inaccuracies of the instruments. However, careless work has been the rule with these instruments and the fact that more useful information has not been acquired is due more to this cause than to the inadequacies of the instruments. As has been demonstrated by the United States Geological Survey and by some of the more scientific field parties, which have not only located magnetic contacts but also interpreted structural features by their use, careful work will produce results which are of inestimable value in the economic development of ore deposits which are deeply covered by an overburden of drift.

The foregoing discussions with regard to magnetic surveying have no reference to the prospecting for ore deposits other than hematites, and for this reason the Swedish method of locating iron-ore deposits by the use of the magnetometer, a method peculiarly adapted to the exploration of magnetite ore, have not been described here.

Van Hise[1] says with regard to the Swedish methods of explorations:

> Because of the conditions above outlined, it is seldom practicable in the Lake Superior region to draw from magnetic observations inferences with regard to the shapes of iron-ore deposits themselves as distinguished from the rest of the iron-bearing formation, such inferences as have been drawn by magnetic surveys of deposits in eastern

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[1] Van Hise, C. R., and Leith, C. K., op. cit., p. 487.

Canada, Sweden, and elsewhere. In these regions the ores consist of magnetite associated with relatively nonmagnetic wall rocks, and the magnetic disturbances are produced by the iron ore itself, not by iron ore and wall rock; hence it is possible to draw satisfactory inferences as to the shape and attitude of the iron-ore deposits. In the Lake Superior region the magnetic attractions are useful in locating iron-bearing formations and thus ultimately the iron ore by underground exploration, but do not directly point out the iron-ore deposits themselves. The highly developed Swedish methods of determining both the intensity and the direction of the magnetic pull are therefore unnecessarily detailed and slow for use in the Lake Superior region, and when attempts have been made to locate ore deposits by them the results have been disappointing.

EXPLORATION BY DRILL.

Van Hise [1] gives a further discussion with regard to the exploration for iron ore by drill in the Lake Superior region, as follows:

> *Exploration for iron ore.*—The location of explorations within the areas of the iron-bearing formations is determined by outcrops, by magnetic lines, by mining, and by general geologic structure. It has been possible to confine most of the exploration to the area of the iron-bearing formations, but in certain districts, notably the Cuyuna, Florence, Crystal Falls, and Iron River districts, the distribution and limits of the iron-bearing formation are so uncertain that much exploratory work has had to be done even to locate the formation. All the facts bearing on the distribution of the iron-bearing formation discussed in this monograph are taken into account by choosing areas for exploration. Some of the larger mining companies employ their own geologists to make special reports on the geology of given areas as a preliminary to underground exploration, and nearly all the explorers make liberal use of all the geologic information available in localizing their work.
>
> As the few ore deposits exposed at the surface were found years ago, explorations are now largely conducted by drilling and sinking test pits and shafts. The large size of the iron-ore deposits makes it possible to find and outline them by drilling to an extent not possible in smaller ore deposits, with the result that the greater number of ore bodies, especially in recent years, are thoroughly explored by drilling before mining begins. It has usually been assumed that if drilling does not locate an ore body it is useless to sink a shaft for this purpose. Mining operations have necessarily disclosed much ore which had not previously been found by drilling, especially in certain districts like the Menominee or the Gogebic, where the structural conditions are such as to make the location of ore by drilling extremely difficult. In the region as a whole, mining operations have almost everywhere disclosed greater reserves of ore than the drilling had indicated.
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> The great dependence placed on drill work has resulted in enormous expenditure for this purpose. Accurate estimates of the amount of drilling done so far in the region can not be made, but a rough estimate compiled from tentative estimates of engineers of the several districts is as follows:

Drilling done for iron ore in the Lake Superior region.

District.	Number of drill holes.	Average depth of drill holes.[a]
		Feet.
Mesabi	15,000	175
Vermilion	1,000	600
Cuyuna	1,500	250
Marquette	5,000	500
Other Michigan ranges and Wisconsin ranges	4,000	300
Total	26,500	....

[a] Estimates probably low.

> This totals 7,200,000 feet, or about 1,363 miles of drilling. At an average cost of $3 a foot, which is a low estimate, the total expenditure has been, roughly, $21,600,000.
>
> It is estimated that at the present time there are 400 drills in operation in the region. In the earlier days of exploration test pits were relied upon to a large extent, espe-

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[1] Van Hise, C. R., and Leith, C. K., op. cit., pp. 484–486.

cially in areas where the surface drift is thin and the water level below the rock surface. This method of exploration, however, is unsatisfactory because of the great depth of the drift at many places, the difficulty of handling water, and the difficulty after finding the ledge of penetrating it by this method. In later years the use of test pits has been largely superseded by drilling.

Both diamond and churn drills are in use. Through surface and soft-ore formations the churn drill is used. Much of the Mesabi district may be so explored. The cost of churn drilling has ranged from $1 to $3.50 and averaged about $2.50 a foot, varying from district to district according to accessibility and cost of transportation and other factors. The cost of diamond drilling has ranged from $2.25 to $8 a foot and averages at present about $3.75, but varies from district to district. Test pits are cheap, averaging perhaps $1.25 a foot.

The necessity for the most careful study of the structural geology in drilling is illustrated by the frequent failure of drills to locate ore deposits even after what seemed to be careful drilling and the subsequent discovery of the deposits either by further drilling or by mining operations. Indeed, as one comes to realize the variety and complexity of underground structural conditions, he is likely to become more and more disinclined to submit a negative report on any property, no matter how extensively it has been drilled. This difficulty is illustrated by the ore shoots in the Gogebic and Menominee districts, many of which have been missed by drilling and picked up in mining operations. Many of the ore shoots in the Vulcan member of the upper Huronian slate of Michigan pitch beneath the surface, following the axes of drag folds, and it is easy for drills to pass one side or the other, or, if the drill hole is inclined, to go above or below them. On examination of drilling plats of exploration areas it is easy to see where linear shoots of ore might pass through at places not penetrated by the drilling. In fact, drilling in some of these localities is almost as uncertain as shooting a bird on the wing. There are many ways of missing the ore. As knowledge of structural conditions increases, however, adverse chances diminish, with the result that in certain areas after the local structural problems are solved, it is possible to drill with a high degree of success.

A higher average of success in drilling would unquestionably result if greater care were taken in the interpretation of drill records. The drill runner is often allowed to report the character of the drillings and the samples are not kept, with the result that many valuable inferences that might be drawn from the lithology, the dip and strike of bedding and cleavage, and other features are lost. Not infrequently also failure to plat drill records in such a manner that they may be considered in three dimensions may cause promising chances for ore to be overlooked.

There has been a considerable tendency to generalize the principles of ore occurrence and in exploration to carry such principles from one district to another. As a matter of fact, although some of the basic principles are general for the region, the local variations of structure require the most careful study of each area to prevent mistakes in interpretation. When explorers of the Gogebic district, where the ores lie in regular, impervious, pitching basins, went to the Mesabi district, where the rocks are of the same age, they naturally attempted to use the same methods in exploration. But here the flatter dip of the formation, the shallowness of basins, the effect of overlying slates in ponding waters, and the unusually large influence of joints in localizing the concentration of ore made the finding of ore largely a new problem, which was solved at much expense and trouble. Recognizing the danger of carrying the method of exploration of one district into another, certain explorers have gone to the other extreme and have attempted to disregard all guides derived from the study of the structural geology, with results even more unsatisfactory than if they had used principles developed for other districts.

Much the greater part of the exploration of the region has been conducted without taking the fullest advantage of all geologic knowledge available, but there has been a rapidly increasing tendency to follow geologic structure, and therefore an increasing demand for geologic information, as shown by the cordial support that the mining men have given to the efforts of the United States and State surveys in this region and by their considerable expenditures for private geologic surveys. Certain of the drilling companies doing contract work now have geologists on their staffs to aid in the interpretation of records, notwithstanding the fact that such interpretation is primarily in the hands of their clients. The problems of underground exploration are followed keenly, intelligently, and energetically by a large number of skilled men in the employ of mining companies, with the result that advances are being made with a rapidity which is sometimes almost bewildering. Six months may see the development of new facts requiring changes in the interpretation of the drilling of a district. The statements as to structural conditions presented in another chapter of this book [Monograph 52] may require some modification by the time the book is given to the public, because of the amount of rapidly accumulating information in the interval between the writing and the printing.

IRON AND STEEL INDUSTRY OF THE UNITED STATES.[1]

PRODUCTION AND VALUE OF PIG IRON BY STATES.

The marketed production of pig iron in 1911 amounted to 23,257,288 long tons, valued f. o. b. at the furnaces at $327,234,624, as compared with 26,674,123 long tons, valued at $412,162,486, in 1910, a decrease in quantity of 3,416,835 tons and in value of $84,827,862. The average value per ton in 1911 was $14 07, and in 1910 it was $15 45, a decrease in 1911 of $1.38 per ton. The figures of marketed pig iron given for 1910 and 1911 were collected by the United States Geological Survey. The values of pig iron for 1907, 1908, 1910, and 1911 were reported to the United States Geological Survey by the manufacturers and represent the approximate value f. o. b. at the furnaces, therefore eliminating freight costs, commissions, etc., which are included in the market prices of pig iron as published in the trade journals. The value for 1909 is an estimate made on a basis similar to that used in estimating the values prior to 1907. The total production of pig iron includes the metal produced from foreign as well as domestic ore. The quantity and value of blast-furnace products derived from ore imported from Cuba, Sweden, Spain, Newfoundland, and Labrador, Canada, and other countries, although it constitutes a very small percentage of the total production, is considerable, since the sales of pig iron alone, derived from foreign ore, amounted in 1911 to 953,685 long tons, valued at $14,000,066.

Quantity and value of pig iron marketed in the United States in 1910 and 1911, by States, in long tons.

State.	1910		1911		Decrease in 1911.		Percentage of decrease in 1911.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Alabama	1,969,770	$24,127,616	1,617,150	$17,379,171	352,620	$6,748,445	17.90	27.97
Illinois	2,606,335	41,465,543	2,036,081	31,152,927	570,254	10,312,616	21.88	24.87
Kentucky	81,677	1,312,288	57,982	870,542	23,695	441,746	29.01	33.66
Michigan	307,975	5,119,074	304,654	4,672,799	3,321	446,275	1.08	8.72
New Jersey	239,221	3,797,656	(a)	(a)	(a)	(a)	(a)	(a)
New York	1,895,018	31,693,623	1,537,201	23,924,194	357,817	7,769,429	18.88	24.51
Ohio	5,584,279	85,385,254	5,371,378	73,484,592	212,901	11,900,662	3.81	13.94
Pennsylvania	11,014,652	174,486,833	9,581,109	136,328,507	1,433,543	38,158,326	13.01	21.87
Tennessee	400,269	5,199,099	297,594	3,439,644	102,675	1,759,455	25.65	33.84
Virginia	402,625	5,576,599	308,789	3,898,285	93,836	1,678,314	23.31	30.10
Wisconsin	278,232	4,386,859	245,152	3,803,049	33,080	583,810	11.89	13.31
Other States [b]	1,894,070	29,612,042	1,900,198	28,380,914	[c] 233,093	[c] 5,028,784	[c] 10.93	[c] 15.05
Total	26,674,123	412,162,486	23,257,288	327,334,624	3,416,835	84,827,862	12.81	20.58

[a] Included in "Other States."

[b] 1910: California, Colorado, Connecticut, Georgia, Indiana, Maryland, Massachusetts, Minnesota, Missouri, Washington, and West Virginia; 1911: California, Colorado, Connecticut, Georgia, Indiana, Maryland, Massachusetts, Minnesota, Missouri, New Jersey, and West Virginia.

[c] Includes decrease in New Jersey.

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[1] The statistics for all steel production and certain statistics for pig iron, as noted on succeeding pages, have been collected and published in the annual reports of the American Iron and Steel Association.

The following table gives the annual average price per long ton of pig iron in the United States for the years 1889 to 1911, inclusive. The prices prior to 1907 include the cost of transportation from blast furnaces to markets. The extreme range in prices, from $9.76 in 1894 to $20.92 in 1902, is of interest in view of present manufacturing conditions.

Average price per long ton of pig iron in the United States, 1889–1911.

Year	Price	Year	Price	Year	Price
1889	$15.78	1897	$9.85	1905	$16.63
1890	16.43	1898	9.90	1906	19.98
1891	15.50	1899	18.00	1907	20.56
1892	14.32	1900	18.85	1908	15.96
1893	11.90	1901	15.25	1909	16.25
1894	9.76	1902	20.92	1910[1]	15.45
1895	11.14	1903	19.12	1911[1]	14.07
1896	10.47	1904	14.13		

The average price of pig iron per long ton, by States, for 1910 and 1911 is given in the following table. This represents the price at the blast furnaces and does not include the prices of ferro-alloys.

Average price per long ton of pig iron in the United States, 1910 and 1911, by States.

State.	1910	1911
Alabama	$12.25	$10.75
Illinois	15.91	15.30
Kentucky	16.07	15.01
Michigan	16.62	15.34
New Jersey	15.88	(a)
New York	16.72	15.56
Ohio	15.29	13.68
Pennsylvania	15.84	14.23
Tennessee	12.99	11.56
Virginia	13.85	12.62
Wisconsin	15.77	15.51
Other States [b]	15.63	14.94
Total	15.45	14.07

[a] Included in "Other States."

[b] 1910: California, Colorado, Connecticut, Georgia, Indiana, Maryland, Massachusetts, Minnesota, Missouri, Washington, and West Virginia; 1911: California, Colorado, Connecticut, Georgia, Indiana, Maryland, Massachusetts, Minnesota, Missouri, New Jersey, and West Virginia.

BLAST FURNACES.

The actual commercial capacity of the blast furnaces of the United States on December 31, 1911, is estimated by Luty[2] at about 33,402,000 tons a year, as compared with about 32,837,000 tons at the close of 1910. These estimates are based on the actual production of the country from July 1, 1906, to July 1, 1907, a period in which demand was heavy and prices of pig iron were high. The theoretical capacity of abandoned furnaces which are still in a state of physical but not commercial existence is not considered.

Four new blast furnaces, with a total annual capacity of 565,000 tons, were added during 1911, as compared with 13 new furnaces, having a total annual capacity of 1,794,000 tons in 1910.

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[1] Prior to 1910, ferroalloys are included with pig iron.

[2] Luty, B. E. V., Iron Trade Review, Jan. 4, 1912, pp. 12–13.

The new furnaces added in 1911 are as follows, the last two, which were practically complete, not having been blown in during that year:

New blast furnaces in 1911.

Date blown in.	Name.	Location.	Size.	Annual capacity.
			Feet.	*Long tons.*
June 8	Haselton No. 4	Youngstown, Ohio	85 by 21½	150,000
July 17	Central D	Cleveland, Ohio		150,000
	River No. 2	Cleveland, Ohio	83 by 20¼	125,000
	Josephine No. 2	Josephine, Pa	85 by 20	140,000

On the basis, then, that the working blast furnace capacity during 1911 was increased by 150,000 tons (the capacity of the two new active furnaces for the half year during which they were in operation), which made a total of 32,987,000 tons, the production of pig iron and other blast-furnace products in 1911, amounting to 23,545,551 tons, approximated 71 per cent of the working capacity of blast furnaces in the United States.

The following table shows the number of blast furnaces in blast on June 30 and December 31, and the total number of stacks recorded for the years 1910 and 1911, but does not of course include the electric reduction furnace at Heroult, Cal.:

Record of blast furnaces in the United States, 1910 and 1911, by States.[a]

State.	Furnaces in blast June 30, 1910.	Dec. 31, 1910.			Furnaces in blast June 30, 1911.	Dec. 31, 1911.		
		In.	Out.	Total.		In.	Out.	Total.
Pennsylvania	116	74	91	165	81	91	73	164
Ohio	50	35	41	76	35	44	31	75
Illinois	20	11	15	26	16	14	10	24
Alabama	24	20	30	50	17	22	27	49
New York	18	15	14	29	15	13	16	29
Virginia	11	9	17	26	7	7	18	25
Tennessee	12	10	10	20	9	8	11	19
Colorado	4	2	4	6	3	3	3	6
Missouri	2	1	1	2	2	1	1	2
Oregon	0	0	1	1	0	0	1	1
Washington	0	0	1	1	0	0	1	1
California	0	0	0	0	0	0	0	0
Maryland	4	2	3	5	3	2	3	5
New Jersey	3	2	7	9	1	0	8	8
Wisconsin	4	4	3	7	2	4	3	7
Minnesota	1	1	0	1	1	0	1	1
Indiana	6	3	6	9	6	7	2	9
Michigan	11	9	7	16	7	8	8	16
West Virginia	1	1	3	4	3	3	1	4
Kentucky	3	2	6	8	3	2	6	8
Georgia	0	1	3	4	0	0	4	4
Texas	0	0	4	4	0	0	4	4
Connecticut	2	3	0	3	0	1	2	3
Massachusetts	1	1	1	2	1	1	1	2
Total	293	206	268	474	212	231	235	466

[a] Statistics of the American Iron and Steel Association.

MONTHLY PRODUCTION OF PIG IRON.

The accompanying diagram (fig. 3) illustrates the course of the manufacture of pig iron by months during the last five years. The sudden decline in production of pig iron at the close of October, 1907,

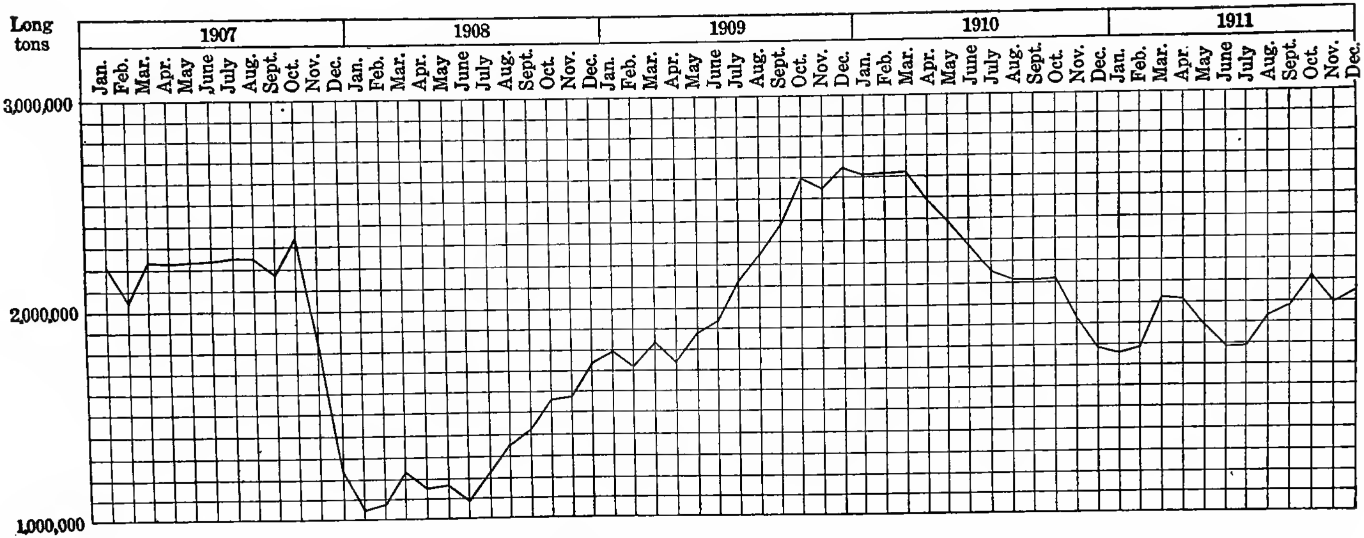

FIGURE 3.—Curve showing production of coke and anthracite pig iron in the United States in 1907, 1908, 1909, 1910, and 1911, by months. Tonnage according to the Iron Age, Nov. 9, 1911, and Mar. 7, 1912.

the low production during the first half of 1908, the slow recovery of activity in the last half of 1908, the hesitating conditions early in 1909, the steady and rapid increase in production during the last part of that year, culminating in December with a record production of more than 2,682,000 tons, the gradual, almost uninterrupted, decline throughout the year 1910, and the moderate production during 1911, broken by alternating declines and recoveries, are graphically indicated.

PRODUCTION OF PIG IRON BY GRADES.

The following table shows the production of the principal grades of pig iron, from 1907 to 1911, inclusive, according to the statistics of the American Iron and Steel Association:

Production of pig iron in the United States, 1907–1911, by grades, in long tons.

Grade.	1907	1908	1909	1910	1911
Bessemer and low phosphorus	13,231,620	7,216,976	10,557,370	11,245,642	9,409,303
Basic (mineral fuel)	5,375,219	4,010,144	8,250,225	9,084,608	8,520,020
Forge pig iron	683,167	457,164	725,624	564,157	408,841
Foundry and ferrosilicon	5,151,209	3,637,622	6,322,415	5,260,447	4,468,940
Malleable Bessemer	920,290	414,957	658,048	843,123	612,533
Spiegeleisen	283,430	111,376	142,831	153,055	110,236
Ferromanganese	55,918	40,642	82,209	71,376	74,482
White, mottled, direct castings, etc	80,508	47,137	56,749	81,159	45,192
Total	25,781,361	15,936,018	25,795,471	27,303,567	23,649,547

PRODUCTION OF PIG IRON ACCORDING TO FUEL USED.

In the following table are given the statistics of the American Iron and Steel Association showing the production of pig iron according to the fuel used, from 1907 to 1911, inclusive:

Production of pig iron according to fuel used, 1907–1911, in long tons.

Fuel used.	1907	1908	1909	1910	1911
Bituminous, chiefly coke	23,972,410	15,331,863	24,721,037	26,257,978	23,141,296
Anthracite and coke	1,335,286	353,315	682,383	628,579	212,548
Anthracite alone	36,268	1,694	16,048	20,503	17,027
Charcoal	437,397	249,146	376,003	396,507	278,676
Total	25,781,361	15,936,018	25,795,471	27,303,567	23,649,547

TOTAL PRODUCTION OF PIG IRON.

The following table shows the production of pig iron in the United States as far as has been recorded. The statistics for years from 1854 to 1911 were collected by the American Iron and Steel Association and include the production of the commoner ferro-alloys; those for 1810, 1840, and 1850 are census figures; those for the other years are largely estimates by early statisticians.

Production of pig iron in the United States, 1810–1911, in long tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1810	53,908	1864	1,014,282	1889	7,603,642
1820	20,000	1865	831,770	1890	9,202,703
1828	130,000	1866	1,205,663	1891	8,279,870
1829	142,000	1867	1,305,023	1892	9,157,000
1830	165,000	1868	1,431,250	1893	7,124,502
1831	191,000	1869	1,711,287	1894	6,657,388
1832	200,000	1870	1,665,179	1895	9,446,308
1840	286,903	1871	1,706,793	1896	8,623,127
1842	215,000	1872	2,548,713	1897	9,652,680
1846	765,000	1873	2,560,963	1898	11,773,934
1847	800,000	1874	2,401,262	1899	13,620,703
1848	800,000	1875	2,023,733	1900	13,789,242
1849	650,000	1876	1,868,961	1901	15,878,354
1850	563,755	1877	2,066,594	1902	17,821,307
1852	500,000	1878	2,301,215	1903	18,009,252
1854	657,337	1879	2,741,853	1904	16,497,033
1855	700,159	1880	3,835,191	1905	22,992,380
1856	788,515	1881	4,144,254	1906	25,307,191
1857	712,640	1882	4,623,323	1907	25,781,361
1858	629,548	1883	4,595,510	1908	15,936,018
1859	750,560	1884	4,097,868	1909	25,795,471
1860	821,223	1885	4,044,526	1910	27,303,567
1861	653,164	1886	5,683,329	1911	23,649,547
1862	703,270	1887	6,417,148		
1863	846,075	1888	6,489,738		

PRICES OF PIG IRON.

In the following table are given the average monthly prices of the principal kinds of pig iron for 1910 and 1911:

Average monthly prices per ton of pig iron, 1910 and 1911, by months and kinds.

Month.	1910				1911			
	No. 2 foundry pig iron at Pittsburgh.[a]	Gray forge pig iron at Pittsburgh.[b]	Bessemer pig iron at Pittsburgh.[b]	Basic pig iron at Philadelphia.[c]	No. 2 foundry pig iron at Pittsburgh.[a]	Gray forge pig iron at Pittsburgh.[b]	Bessemer pig iron at Pittsburgh.[b]	Basic pig iron (eastern Pennsylvania and nearby points).[c]
January	$17.94	$17.15	$19.90	$18.75	$14.75	$14.09	$15.90	$14.25
February	17.38	17.15	19.42	18.56	14.81	14.15	15.90	14.44
March	17.00	16.60	18.90	18.25	14.96	14.15	15.90	15.25
April	16.75	16.35	18.15	17.56	15.00	14.15	15.90	15.19
May	16.18	16.09	17.09	16.69	14.72	14.02	15.90	14.75
June	15.53	15.10	16.73	16.10	14.56	13.90	15.90	14.50
July	15.40	14.52	16.40	15.68	14.53	13.90	15.90	14.38
August	15.16	14.45	16.21	15.12	14.47	13.90	15.90	14.65
September	14.93	14.25	15.90	15.00	14.40	13.90	15.90	14.69
October	14.88	14.15	15.90	15.00	14.34	13.84	15.39	14.50
November	14.78	14.09	15.90	14.75	14.25	13.60	15.10	14.50
December	14.65	13.90	15.90	14.75	13.90	13.46	15.15	14.25

[a] Eng. and Min. Journ., Jan. 13, 1912.
[b] Iron Trade Review, Jan. 5, 1911, and Jan. 4, 1912
[c] Iron Age, Jan. 5, 1911, and Jan. 4, 1912.

FERRO-ALLOYS.

PRODUCTION.

The United States Geological Survey has undertaken for the first time to present the statistics of production of ferro-alloys separately from those of pig iron, with which they have been heretofore included.

Although the quantity of ferro-alloys is small, amounting to only about one-eighth of the average production of pig iron for one month or to about 1.24 per cent of the total production of pig iron during the year, the value per ton is so much greater as to have an important influence on the apparent value of the pig iron if included with it; therefore it has been decided to separate the two subjects. There is a sufficient number of producers of the commoner ferro-alloys, such as ferromanganese, spiegeleisen, ferrosilicon, and ferrophosphorus to give the production of these two groups of alloys separately; but the production of the rarer alloys, such as ferromolybdenum, ferrotitanium, ferrotungsten, and ferrovanadium, must be grouped together. It should also be stated that the values of the first two groups of ferro-alloys have been in part estimated by the Survey.

The total marketed production of ferro-alloys in 1911 as reported to the United States Geological Survey was 253,375 long tons, valued at $8,377,832. Of this production 91,612 long tons, valued at $4,084,836, were made from imported ores. The ferrovanadium, ferromolybdenum, ferromanganese, and spiegeleisen contributed largely to the total alloys containing imported ore. The total quantity reported does not represent the total production of the United States, since the production of considerable quantities of electrically produced ferro-alloys was not reported to the Survey.

The sales of ferromanganese and spiegeleisen amounted to 178,615 long tons, valued at $4,746,541, and of ferrosilicon and ferrophosphorus to 70,122 long tons, valued at $1,345,884. This represented a decided decrease in both quantity and value for the first group, whose production amounted to 226,216 long tons, valued at $6,011,723 in 1910, and an increase in quantity but a decrease in value for the second group as compared with the production in 1910, which was 62,647 long tons, valued at $1,411,779. The sales of alloys of iron with the rarer metals, molybdenum, titanium, tungsten, vanadium, and others not specified, amounted in 1911 to 4,638 long tons, valued at $2,285,407, or an average price of nearly $493 per ton. Of this total the quantity of ferrotitanium predominated. There are no statistics of the production of these latter alloys in 1910 for comparison.

The following table gives a partial outline of the ferro-alloy market in the United States in 1910 and 1911:

Marketed production of ferro-alloys in 1910 and 1911.

Kind of alloy.	1910		1911	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Ferromanganese and spiegeleisen	226,216	$6,011,723	178,615	$4,746,541
Ferrosilicon and ferrophosphorus	62,647	1,411,779	70,122	1,345,884
Ferromolybdenum	(a)	(a)	4,638	2,285,407
Ferrotitanium (10 to 20 per cent titanium)				
Ferrovanadium				
Ferrotungsten (about 50 per cent tungsten)				
Other				
Total	288,863	7,423,502	253,375	8,377,832

a Not collected for 1910 by United States Geological Survey.

IMPORTS.

According to the Bureau of Statistics, the imports for consumption of ferromanganese into the United States in 1911 were 80,263 long tons, valued at $3,015,062, as compared with 114,228 long tons, valued at $4,341,071, in 1910, and those of spiegeleisen in 1911 were 20,970 long tons, valued at $405,444, as compared with 25,383 long tons, valued at $489,049, in 1910. The imports of the alloys of the rarer metals are not all reported separately. For instance, the imports of ferrochrome are combined with those of chromium; those of ferromolybdenum are combined with those of the metal molybdenum, and those of ferrotungsten are included with those of tungsten. For the sake of comparison, however, such statistics as are available are presented in the following table:

Imports of ferro-alloys in 1910 and 1911, in long tons.

	Value per ton.	1910		1911	
		Long tons.	Value.	Long tons.	Value.
Chrome or chromium and ferrochrome.	$200 or less	446	$41,090	240.03	$20,173
	More than $200	53	38,339	13.50	7,729
Total		499	79,429	253.53	27,902
Ferrophosphorus	Less than $200	146	5,171	186.13	8,520
Ferrosilicon	15 per cent or less silicon	2,240	44,115	....	....
	More than 15 per cent silicon	9,152.14	483,042	6,658.00	341,681
Total		11,392.14	527,157		
Ferrovanadium	More than $300	0	0	1.07	2,623
Molybdenum and ferromolybdenum.	More than $200	9.04	14,402	8.50	11,409
Ferrotitanium	$200 or less	1.04	260	.69	97
	More than $200	1.00	507	45.00	22,403
Total		2.04	767	45.69	22,500
Tungsten and ferrotungsten.	More than $200	528	678,534	115.07	143,802
Ferromanganese		114,228	4,341,071	80,263	3,015,062
Spiegeleisen		25,383	489,049	20,970	405,444

ELECTRIC SMELTING OF IRON ORE.

The direct reduction of iron ore by means of the electric current is a problem that has engaged the attention of certain electrometallurgists for the last 10 or 12 years. According to Kershaw[1] the first experiments were made by Capt. Stassano, an Italian, at Rome, in 1899–1901, and later at Darfo, in northern Italy, where cheaper electric power was available. Stassano's furnace was of a revolving arc type with 3-phase current and water-cooled electrodes, and this type of furnace is still employed by Stassano for refining steel by electricity. Stassano's experiments proved that good iron could be produced in this way direct from the ore. The iron ore was first ground, and after mixing with lime and coke, was briquetted before being charged into the furnace—an expensive preliminary treatment. The power required in this process was estimated to be 2,866 kilowatt hours per ton, costing $18.60, and when the cost of materials and labor were added to the already exorbitant power cost the impracticability of the process from a financial standpoint was readily apparent. Keller, a French electrometallurgist, carried on extended experiments in his own electric furnace at Kerrouse and Livet, France, from 1901 to 1905. In the Keller process the ore, coke, and limestone were coarsely crushed and mixed before charging into the furnace, which had two shafts connected below by a canal which collected the molten iron. A reduction in power and costs were accomplished by the Keller process, which is estimated to have required 2,292 kilowatt hours of power for a ton of 2,000 pounds at a cost of $12.05.

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[1] Kershaw, J. B. C., Electric furnace methods of iron production: Iron Trade Rev., Jan. 4, 1912, pp. 41-46.

In America Heroult, another French electrometallurgist, made a trial of a shaft type of furnace at Sault Ste. Marie, Canada, in 1905–6, under the auspices of the Canadian Government. This early Heroult furnace was of the square shaft type and was much simpler than those of Stassano and Keller, and by its use it was estimated that the consumption of power for a large plant would approximate 1,490 kilowatt hours per ton of pig iron, at a cost of only $2.43. The estimated cost of native magnetite iron ore was $1.50 per ton; of charcoal, which was used instead of coke, $6 per ton of iron; and of labor about 76 cents—a total cost of $10.69 for labor, ore, and power supply requisite for a ton of pig iron. These costs were not, however, attained by actual practice, and the project of establishing an electric iron smelting industry on the Canadian side of the Great Lakes was, temporarily at least, abandoned. In 1906 to 1910 three Swedish engineers, Gronwall, Lindblad, and Stalhane, carried on extensive experimental work on the problem, building with the assistance of a number of iron manufacturers in Sweden two electric furnaces at Domnarfvet, and a third at Trollhättan. The design of the Gronwall electric furnace is similar to that of a miniature blast furnace with the tuyeres replaced by electrodes. Dr. Haanel, director of the mines branch of the Canada Department of Mines, made a series of test trials with the Gronwall furnace at Domnarfvet in 1908, using Grangesberg magnetite. Based on the yield under favorable conditions it has been estimated that the power consumption might be reduced to less than 2,000 kilowatt hours per ton of pig iron, and that for a furnace producing 8,000 to 10,000 tons of pig iron per annum the cost of charcoal, power, labor, electrodes, and repairs should total about $8.56 per ton of iron, to which must be added for cost of ore, interest on capital, depreciation of plant, machinery, etc., about $5 per ton, making the total cost of a ton of pig iron $13.56. At Trollhättan, where there is abundant water power, a much larger plant has been erected than at Domnarfvet. This plant was completed late in 1910 and has made a considerable quantity of pig iron said to be of exceptionally good quality, containing only small percentages of sulphur and phosphorus. Since this furnace has been operating the weekly production of pig iron has been increased, the electrode consumption has been greatly decreased, the consumption of charcoal has been decreased, and the power consumption has been reduced to an equivalent of only 1,735 kilowatt hours per ton of 2,204 pounds of pig iron, at a cost of $13 for the power. It is expected that the year 1912 will witness an extension of the Scandinavian electric smelting industry, four large electric pig iron furnaces of the Gronwall type having been planned for erection at Domnarfvet and Hagfors, Sweden, and at Tyassaa, Norway. Thus it seems that the future of the electric iron smelting industry in Scandinavia is fairly well assured. This is due mainly to the favorable conditions that prevail there. High-grade iron ore, carrying between 60 and 65 per cent of metallic iron, is abundant, and electric power, developed from large waterfalls, is relatively cheap. There are no coal beds, and charcoal must be used for iron making. Charcoal is produced from the abundant timber, but the possibility of replacing two-thirds of the quantity required in iron making by electric power is a very important factor.

In the United States the only locality in which electric iron smelting has been attempted is in northern California. Here the physical conditions resemble in many ways those in Scandanavia, just described. No coking coal beds are near at hand, but timber for making charcoal is plentiful. Electric power is produced in excess of the demand from industries outside of iron smelting, but the water supply is limited in summer and autumn. The pig iron market in San Francisco is favorable to a small local iron industry, since heretofore supplies have had to be shipped mainly from Illinois and Colorado, or imported from abroad. A Heroult furnace was erected in Shasta County for the Noble Electric Steel Co., and placed in operation in July, 1907. This furnace is described by R. L. Phelps.[1] It was designed to utilize 1,500 kilowatts in the form of 3-phase current at 50 volts. The charge consisted of charcoal, limestone, and magnetite. The heat for smelting the ore resulted from the resistance of the slag and charge to the current as it passed from the electrodes to the neutral point at the bottom of the furnace. At the start the electrodes were in slight contact with the neutral bottom of the furnace, but as the charge became heated the electrodes were drawn out of the molten iron and remained in the slag and charge. It did not fulfill expectations, however, the output never exceeding 11 tons of pig iron per day, and a second furnace, designed by Prof. Dorsey Lyon,[2] was erected. This furnace was smaller than the first, being of 160 kilowatt capacity, and was designed to run with 4,000 amperes at 35 volts, single-phase current. This furnace differed considerably in design from the first one erected. It was started early in 1908 and made an experimental run for 46 days. The lowest power consumption reported to have been attained was 3,066 kilowatt hours per ton of pig iron. The output of the furnace was 2,400 pounds of iron in 24 hours. In order to reduce this power consumption a larger furnace capable of continuous runs was next erected. This third furnace is built on the same general lines as the second, but has a capacity of 1,500 kilowatts and employs 3-phase current. The charge is dried in a preheater which utilizes stack gases, and the charging is done mechanically. There are six electrodes arranged equidistantly around the furnace, and the current passing through the ore lying between them in the crucible melts the charge. The molten metal and the slag are drawn off as in ordinary blast-furnace practice. Charcoal for this plant is supplied by a wood carbonizing plant which has been erected near the furnace, and such by-products as wood alcohol, acetic acid, tar, and creosote oils are obtained. Kershaw[3] gives a tabular summary of comparative costs of electrically produced pig iron, which is given below, with the addition of dates.

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[1] Phelps, R. L., The electrical smelting of iron ore: Min. and Sci. Press, July 20, 1907, pp. 87–88.
[2] Lyon, Dorsey, Trans. Electromet. Soc., vol. 15, 1909, pp. 39–49.
[3] Kershaw, J. B. C., op. cit., p. 45.

Comparative costs of electrically produced pig iron.

Date.	Type of furnace.	Location.	Power kilowatt hours.	Estimated cost (2,204 pounds).	Notes.
1903	Stassano	Darfo, Italy	2,866	$18.60	Power at $9 per electric horsepower year.
1904	Keller	Livet, France	2,589	13.27	
1906	Heroult	Sault Ste. Marie, Canada	1,642	11.77	Power at $10.71 per electrical horsepower year; ore $1.50 per ton.
1908	Gronwall	Trollhättan, Sweden	1,957	13.56	Estimate based on early trials.
1910	do	do	1,735	13.00	Actual results obtained at Trollhättan, Sept. 3, 1911.
1910	Heroult	Heroult, Shasta Co., Cal		15.00	Power at $12 per electrical horsepower year; ore, $1.50 per ton.

With regard to the future of electric smelting of pig iron there are certain controlling factors that will doubtless limit it to localities like Trollhättan and Heroult where all physical and commercial conditions are favorable to its development. The main point seems to be that the saving in coke effected by the use of electric heating is so small that electric power must be produced or sold at a cost of $8 to $10 per electrical horsepower year, a figure far below the possibilities of the great majority of hydroelectric power stations at present. The electric process is also further handicapped by the cost of carbon electrodes, an expense which the ordinary blast furnace does not have to bear. These conclusions, it should be noted, have no bearing on the refining of steel in the electric furnace, a practice which is already established, and is rapidly expanding in Europe and America.

A few of the recent papers in English bearing on the subject of production of pig iron by the use of electric energy are given in the following list:

Publications on electric smelting of iron ore.

ANON., Electric iron ore smelting at Trollhättan, Sweden: Engineering, June 16, 1911, pp. 778–781.

ANON., The Trollhättan hydro-electric power station, Sweden: Engineering, Sept. 22, 1911, pp. 374–379.

BENNIE, P. MCN., Electric furnace pig iron in California: Trans. Am. Electrochem. Soc., vol. 15, 1909, pp. 35–37.

——— Progress in electrosiderurgy: Quart. Bull. Canadian Min. Inst., June, 1910; pp. 31–46.

——— Electric furnace—its place in siderurgy: Proc. Eng. Soc. Western Pennsylvania, January, 1911.

CAMPBELL, D. F., Progress in the electrometallurgy of iron and steel (abstr. read to Faraday Soc., October, 1911): Iron and Coal Trade Rev., Oct. 13, 1911, p. 611.

CATANI, R., Large electric furnaces in the electrometallurgy of iron and steel: Trans. Am. Electrochem. Soc., vol. 15, 1909, pp. 159–171. (See also Iron and Steel Inst. Jour., October, 1911, and Iron and Coal Trades Rev., Oct. 6, 1911.)

——— The applications of electricity in the metallurgical industry of Italy: Met. and Chem. Eng., December, 1911, pp. 642–649.

FRICK, OTTO, The electric reduction of iron ores (with special reference to Trollhättan, Sweden, and Noble furnace at Heroult, Cal.): Met. and Chem. Eng., December, 1911; pp. 631–637.

FULLER, S. J., Production of pig iron by electricity (reviews Trollhättan experiments): U. S. Cons. Repts., July 19, 1911, p. 273; Oct. 14, 1911, p. 248.

HAANEL, EUGENE, Report of committee appointed to investigate the different electrothermic processes for the smelting of iron ores and the making of steel in Europe: Dept. Interior, Ottawa, Canada, 1904.

Haanel, Eugene, The electric shaft furnace of the Aktiebolaget Elektrometall, Ludviga, Sweden: Trans. Am. Electrochem. Soc., vol. 15, 1909, pp. 25–33.

——— Recent advances in the construction of electric furnaces for the production of pig iron, steel, and zinc: Bull. Canada Dept. Mines No. 3, Ottawa, 1910, 76 pp.

Keller, C. A., A contribution to the study of electric furnaces as applied to the manufacture of iron and steel: Trans. Am. Electrochem. Soc., vol. 15, 1909, pp. 87–125.

Kershaw, J. B. C., Electric furnace methods of iron production (recent developments in electric iron ore smelting mediums, with descriptions of the various furnaces in use): Iron Trade Rev., Jan. 4, 1912, pp. 41–46.

Knesche, J. A., Electric smelting of ore in the United States: Iron Trade Rev., Jan. 5, 1911, pp. 65–77. Illus.

Leffler, J. A., Electric iron smelting at Trollhättan, Sweden: Iron and Coal Trade Rev., June 9, 1911, pp. 957–962.

——— Electric iron ore smelting at Trollhättan, Sweden: Engineering, June 16, 1911, pp. 778–780; June 23, pp. 811–814; June 30, pp. 846–847.

——— An electric furnace for smelting iron ore: Iron Trade Rev., July 20, 1911, pp. 121–124.

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PRODUCTION OF STEEL BY STATES AND KINDS.

The following five tables show the production of the various steels, according to the statistical report for 1911 of the American Iron and Steel Association. The production of Bessemer steel ingots and castings in the leading States from 1907 to 1911, inclusive, was as follows:

Production of Bessemer ingots and castings, 1907–1911, by States, in long tons.

State.	1907	1908	1909	1910	1911
Pennsylvania	4,351,841	2,106,382	2,845,602	2.975,750	2,338,813
Ohio	3,636,679	1,955,446	3.466,077	3,314,053	3,268,994
Illinois	1,723,073	1,237.747	1,632,444	1,693,053	1,335,053
Other States	1,955,956	817,180	1,386,660	1,429,916	1,004,994
Total	11,667,549	6,116,755	9,330,783	9,412,772	7,947,854

In the following table is given the production of open-hearth steel ingots and castings in the leading States from 1907 to 1911, inclusive:

Production of open-hearth steel ingots and castings, 1907–1911, by States, in long tons.

State.	1907	1908	1909	1910	1911
New England States	239,797	158,417	257,392	223,158	189,879
New York and New Jersey	706,019	350,348	618,117	713,245	679,152
Pennsylvania	7,868,353	5,322,229	9,400,287	10,153,816	9,594,914
Ohio	819,642	525,171	1,424,452	1,733,409	1,721,549
Indiana	181,662	167,299	783,957	1,307,129	1,394,520
Illinois	1,013,251	483,104	1,052,572	995,011	801,624
Other States	721,012	830,161	957,159	1,378,741	1,217,012
Total	11,549,736	7,836,729	14,493,936	16,504,509	15,598,650

The following table gives the production, by States, of basic and acid open-hearth steel ingots and castings in 1911:

Production of basic and acid open-hearth steel ingots and castings in 1911, by States, in long tons.

State.	Basic open-hearth steel.	Acid open-hearth steel.	Total.
New England States	155,488	34,391	189,879
New York and New Jersey	630,421	48,731	679,152
Pennsylvania	8,913,868	681,046	9,594,914
Ohio	1,670,481	51,068	1,721,549
Indiana	1,371,614	22,906	1,394,520
Illinois	767,383	34,241	801,624
Other States	1,176,677	40,335	1,217,012
Total	14,685,932	912,718	15,598,650

The following table gives the production of all kinds of steel ingots and castings in 1910 and 1911:

Production of all kinds of steel ingots and castings in 1910 and 1911, by States, in long tons.

State.	1910				1911			
	Bessemer.	Open-hearth.	Crucible and all other.	Total ingots and castings.	Bessemer.	Open-hearth.	Crucible and all other.	Total ingots and castings.
Massachusetts, Rhode Island, Maine, and Connecticut	2,592	223,158	23,751	249,501	1,411	189,879	20,004	211,294
New York and New Jersey	740,529	713,245	34,856	1,488,630	355,717	679,152	34,692	1,069,561
Pennsylvania	2,975,750	10,153,816	77,973	13,207,539	2,338,813	9,594,914	56,796	11,990,523
Delaware, Maryland, District of Columbia, Virginia, West Virginia, Kentucky, Georgia, Alabama, Louisiana, and Texas[a]	589,949	897,219	....	1,487,168	529,799	764,934	100	1,294,833
Ohio	3,314,053	1,733,409	3,146	5,050,608	3,268,994	1,721,549	3,567	4,994,110
Indiana and Illinois	1,693,053	2,302,140	31,247	4,026,440	1,335,053	2,196,144	7,596	3,538,793
Other States	96,846	481,522	6,665	585,033	118,067	452,078	6,847	576,992
Total	9,412,772	16,504,509	177,638	26,094,919	7,947,854	15,598,650	129,602	23,676,106

[a] Figures for 1911 include Tennessee.

PRODUCTION OF ELECTRIC AND MISCELLANEOUS STEEL.

Statistics of the American Iron and Steel Association show that the total electric production of steel in 1911 was 29,105 long tons as compared with 52,141 tons in 1910, a decrease of 23,036 tons. In 1911 there were 9 plants which made steel by the electric process as follows: Massachusetts, 1; New York, 3; Pennsylvania, 3; Indiana, 1; and Illinois, 1; as compared with a total of 7 plants in 1910 in the same States. In 1911 about 27,227 tons were ingots and about 1,878 tons were castings, and in 1910 about 50,821 tons were ingots and about 1,320 tons were castings. The total production of electric steel in 1911 includes about 6,722 tons of alloy steel ingots and castings of which about 6,612 tons were ingots and about 110 tons were castings. In 1910 the production of electric alloy steel was about 608 tons, of which 600 tons were ingots and 8 tons were castings.

TOTAL PRODUCTION OF STEEL.

The statistics of the production of various kinds of steel, so far as has been recorded, are given in the following table. The first steel produced in this country was probably made in Connecticut in 1728 by Samuel Higley and Joseph Dewey. Crucible steel was first successfully produced in the United States in 1832 at the works of William and John H. Garrard, at Cincinnati, Ohio. Bessemer steel was first made in this country in September, 1864, by William F. Durfee at an experimental plant at Wyandotte, Mich., and open-hearth steel in 1864 by the New Jersey Steel & Iron Co. at Trenton, N. J.

Production of steel in the United States, 1810–1911, in long tons.

Year.	Bessemer.	Open-hearth.	Crucible.	Other steel.	Total.
1810	....	....	917		917
1860	....	....	11,838		11,838
1863	....	....	8,075		8,075
1864	....	....	9,258		9,258
1865	....	....	13,627		13,627
1866	....	....	16,940		16,940
1867	2,679	....	16,964		19,643
1868	7,589	....	19,197		26,786
1869	10,714	893	19,643		31,250
1870	37,500	1,339	29,911		68,750
1871	40,179	1,785	31,250		73,214
1872	107,239	2,679	26,125	6,911	142,954
1873	152,368	3,125	31,059	12,244	198,796
1874	171,369	6,250	32,436	5,672	215,727
1875	335,283	8,080	35,180	11,256	389,799
1876	469,639	19,187	35,163	9,202	533,191
1877	500,524	22,349	36,098	10,647	569,618
1878	653,773	32,255	38,309	7,640	731,977
1879	829,439	60,259	50,696	4,879	935,273
1880	1,074,262	100,851	64,664	7,558	1,247,335
1881	1,374,247	131,202	80,145	2,720	1,588,314
1882	1,514,687	143,341	75,973	2,691	1,736,692
1883	1,477,345	119,356	71,835	4,999	1,673,535
1884	1,375,531	117,515	53,270	4,563	1,550,879
1885	1,519,430	133,376	57,599	1,515	1,711,920
1886	2,269,190	218,973	71,973	2,367	2,562,503
1887	2,936,033	322,069	75,375	5,594	3,339,071
1888	2,511,161	314,318	70,279	3,682	2,899,440
1889	2,930,204	374,543	75,865	5,120	3,385,732
1890	3,688,871	513,232	71,175	3,793	4,277,071
1891	3,247,417	579,753	72,586	4,484	3,904,240
1892	4,168,435	669,889	84,709	4,548	4,927,581
1893	3,215,686	737,890	63,613	2,806	4,019,995
1894	3,571,313	784,936	51,702	4,081	4,412,032

Production of steel in the United States, 1810–1911, in long tons—Continued.

Year.	Bessemer.	Open-hearth.	Crucible.	Other steel.	Total.
1895	4,909,128	1,137,182	67,666	858	6,114,834
1896	3,919,906	1,298,700	60,689	2,394	5,281,689
1897	5,475,315	1,608,671	69,959	3,012	7,156,957
1898	6,609,017	2,230,292	89,747	3,801	8,932,857
1899	7,586,354	2,947,316	101,213	4,974	10,639,857
1900	6,684,770	3,398,135	100,562	4,862	10,188,329
1901	8,713,302	4,656,309	98,513	5,471	13,473,595
1902	9,138,363	5,687,729	112,772	8,386	14,947,250
1903	8,592,829	5,829,911	102,434	9,804	14,534,978
1904	7,859,140	5,908,166	83,391	9,190	13,859,887
1905	10,941,375	8,971,376	102,233	8,963	20,023,947
1906	12,275,830	10,980,413	127,513	14,380	23,398,136
1907	11,667,549	11,549,736	131,234	14,075	23,362,594
1908	6,116,755	7,836,729	63,631	6,132	14,023,247
1909	9,330,783	14,493,936	107,355	22,947	23,955,021
1910	9,412,772	16,504,509	122,303	55,335	26,094,919
1911	7,947,854	15,598,650	97,653	31,949	23,676,106

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[a] Numbers of folios containing important notes on iron ores are printed in italics.

Government Exhibit No. 365

IRON ORE, PIG IRON, AND STEEL.

By Ernest F. Burchard.

INTRODUCTION.

The iron and steel industry of the United States, after having experienced a deep depression in 1908, practically recovered during 1909 the position it formerly held, but made no gains over the total business of 1907. The slow recovery of activity characteristic of the last part of 1908 continued during the early months of 1909, but at first with much uncertainty. The curve showing pig-iron production by months for the years 1907, 1908, and 1909 (see fig. 2) affords a graphic outline of the general condition of the industry in these years. From April to October, 1909, there was a steady and rapid increase in the output of pig iron, with a slight lull in November, followed by a record-breaking production in December, which averaged 86,500 tons a day, as compared with 55,600 tons a day in December, 1908. On December 31, 1909, there were 338 furnaces in blast out of a total of 469; on the same date in 1908 there were 236 furnaces in blast out of a total of 459.

As a consequence of the recovery of normal conditions in 1909 the iron-ore output was brought up to nearly the total for 1907. The total quantity of iron ore produced in 1909, not including stocks left at mines, was 51,294,271 long tons, as compared with 35,983,336 tons in 1908 and with 51,720,619 tons in 1907; the output of pig iron in 1909 was 25,795,471 long tons, as compared with 15,936,018 tons in 1908 and with 25,781,361 tons in 1907. The total production of all kinds of steel ingots and castings in 1909 amounted to 23,955,021 long tons, as compared with 14,023,247 long tons in 1908 and with 23,362,594 tons in 1907.

In 1908 an agreement among iron and steel makers to refrain from destructive competition maintained fairly steady though not high prices for their products, notwithstanding the light demand. Prices during the last half of 1908 were generally lower than during the first half of the year. In February, 1909, an open market was declared by iron and steel manufacturers on finished products except rails, and as a result prices sagged to comparatively low levels, reaching the minimum in April and May. The last half of the year showed a steady recovery in prices to points at or slightly above those prevailing at the end of 1908 for most finished steel products, except wire nails, and to points $1 to $2.50 higher for pig iron.

The increase in the production of iron ore in 1909 over that of 1908 was more than 42 per cent, and the increase in the production of pig iron and steel was about 62 per cent and 70 per cent, respectively.

The accompanying figure shows the production of iron ore, pig iron, and steel since 1870, and illustrates well the great decrease which followed the financial panic of October, 1907.

The statistics of production of iron ore for 1909 were collected by the United States Geological Survey in cooperation with the Bureau of the Census, and the compilation of the replies to the numerous and detailed inquiries contained in the general census schedule has delayed the statistics far beyond the time at which the Geological Survey usually presents them to the public. Cordial thanks are due the various mine owners and operators for the promptness and courtesy with which they have replied to the various requests of the Survey for information.

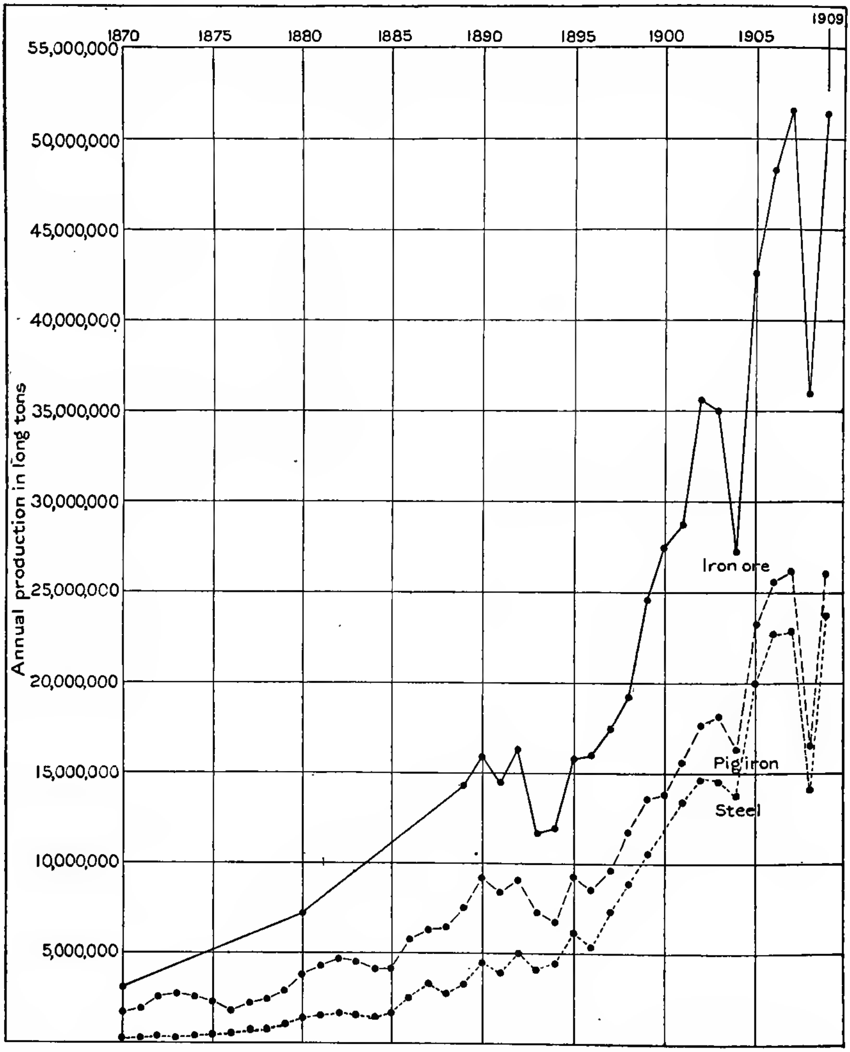

FIGURE 1.—Curve showing the production of iron ore, pig iron, and steel in the United States, 1870–1909, in long tons.

IRON-ORE INDUSTRY OF THE UNITED STATES.

PRODUCTION OF IRON ORE BY COMMERCIAL DISTRICTS.

The iron ore produced in the United States in 1909 amounted to 51,294,271 long tons, valued at $110,290,596 at the mines, as compared with 35,983,336 long tons, valued at $81,845,904, produced in 1908. This represents an increase of 42.5 per cent in tonnage and of 34.7 per cent in value. Notwithstanding this large increase, the production of iron ore in 1909 did not quite reach the high record made in 1907.

Iron ore was mined in 26 States during 1909. Of these, four States—Montana, Nevada, New Mexico, and Wyoming—produced ores for fluxing purposes only; the rest produced ores for blast furnace use.

The various States in which iron ore occurs may be conveniently grouped into six commercial districts, namely:

1. *Northeastern district:* Including Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, and Ohio.
2. *Southeastern district:* Including Maryland, the Virginias, Kentucky, Tennessee, North Carolina, Georgia, and Alabama.
3. *Lake Superior district:* Including Michigan, Wisconsin, and Minnesota.
4. *Mississippi Valley district:* Including Iowa, Missouri, Arkansas, and Texas.
5. *Rocky Mountain district:* Including Montana, Wyoming, Colorado, New Mexico, Utah, and Nevada.
6. *Pacific Slope district:* Including Washington and California.

Each of these districts may be subdivided into mining districts and the ores classified with regard to variety and to distribution of deposits. These subdivisions are discussed in another section. The Lake Superior is by far the most important of these districts and is followed in order by the southeastern district and the northeastern district; the Mississippi Valley and the western districts are of minor importance. The following table shows the relative output of iron ore in each of the commercial districts during 1907, 1908, and 1909:

Production of iron ore in the United States, by commercial districts, in 1907, 1908, and 1909, in long tons.

District.	1907.		1908.		1909.	
	Quantity.	Percentage of total.	Quantity.	Percentage of total.	Quantity.	Percentage of total.
Northeastern	2,822,822	5.46	1,590,098	4.42	2,280,741	4.45
Southeastern	6,197,360	11.98	5,484,821	15.24	6,197,717	12.08
Lake Superior	41,638,744	80.51	28,225,412	78.44	41,942,969	81.77
Mississippi Valley	230,435	.44	154,380	.43	96,428	.19
Rocky Mountain	[1]831,258	1.61	[1]528,625	1.47	[1]776,416	1.51
Pacific Slope	(a)	....	(a)	....	(a)	....
	51,720,619	100.00	35,983,336	100.00	51,294,271	100.00

a Pacific slope included in Rocky Mountain district.

PRODUCTION OF IRON ORE, BY STATES.

The following table gives a comparison of the iron-ore production, by States, for 1908 and 1909, showing increase and decrease and the percentage of increase and decrease in the several States.

Quantity and value of iron ore produced in the United States, 1908 and 1909, by States.

State.	1908.		1909.		Increase (+) or decrease (—) in 1909.		Percentage of increase (+) or decrease (—) in 1909.	
	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.	Quantity, in long tons.	Value.
Alabama	3,734,438	$4,358,902	4,321,252	$4,996,455	+ 586,814	+ $637,553	+15.71	+14.63
Colorado	10,176	18,432	10,000	16,000	— 176	— 2,432	— 1.73	—13.19
Connecticut and Massachusetts	28,112	105,457	38,272	141,274	+ 10,160	+ 35,817	+36.14	+33.96
Georgia	321,060	540,189	221,016	332,478	— 100,044	— 207,711	—31.16	—38.45
Kentucky, Maryland, and West Virginia	53,235	84,898	98,657	157,073	+ 45,422	+ 72,175	+85.32	+85.01
Michigan	8,839,199	25,150,861	11,900,384	32,282,622	+ 3,061,185	+ 7,131,761	+34.63	+28.36
Minnesota	18,652,220	42,313,974	28,975,149	60,253,314	+10,322,929	+17,939,340	+55.34	+42.40
Missouri	98,414	218,182	89,954	210,853	— 8,460	— 7,329	— 8.60	— 3.36
Montana, Nevada, New Mexico, Utah, Washington, and Wyoming	518,449	708,760	766,416	955,775	+ 247,967	+ 247,015	+47.83	+34.85
New Jersey	394,767	1,162,474	543,720	1,607,003	+ 148,953	+ 444,529	+37.73	+38.24
New York	697,473	2,098,247	1,015,333	3,072,323	+ 317,860	+ 974,076	+45.57	+46.42
North Carolina	48,522	76,877	61,150	107,013	+ 12,628	+ 30,136	+26.03	+39.20
Ohio	26,585	36,736	16,527	28,547	— 10,058	— 8,189	—37.83	—22.29
Pennsylvania	443,161	572,346	666,889	792,672	+ 223,728	+ 220,326	+50.48	+38.50
Tennessee	635,343	876,007	657,795	907,282	+ 22,452	+ 31,275	+ 3.53	+ 3.57
Texas	55,966	30,663	6,474	9,318	— 49,492	— 21,345	—88.43	—69.61
Virginia	692,223	1,465,691	837,847	1,693,188	+ 145,624	+ 227,497	+21.04	+15.52
Wisconsin	733,993	2,027,208	1,067,436	2,727,406	+ 333,443	+ 700,198	+45.43	+34.54
Total	35,983,336	81,845,904	51,294,271	110,290,596	+15,310,935	+28,444,692	+42.55	+34.75

In the following table the States are arranged according to their rank as producers in 1908 and 1909, with regard both to the quantity and the value of the iron ore produced:

Rank of iron ore producing States in 1908, and 1909, with quantity and value of product and percentage of each.

1908.

Production.				Value.			
Rank.	State.	Quantity, in long tons.	Percentage of total production.	Rank.	State.	Amount.	Percentage of total value.
1	Minnesota	18,652,220	51.84	1	Minnesota	$42,313,974	51.70
2	Michigan	8,839,199	24.56	2	Michigan	25,150,861	30.73
3	Alabama	3,734,438	10.38	3	Alabama	4,358,902	5.33
4	Wisconsin	733,993	2.04	4	New York	2,098,247	2.56
5	New York	697,473	1.94	5	Wisconsin	2,027,208	2.48
6	Virginia	692,223	1.92	6	Virginia	1,465,691	1.79
7	Tennessee	635,343	1.77	7	New Jersey	1,162,474	1.42
8	Montana, Nevada, New Mexico, Utah, Washington, and Wyoming	518,449	1.44	8	Tennessee	876,007	1.07
9	Pennsylvania	443,161	1.23	9	Montana, Nevada, New Mexico, Utah, Washington, and Wyoming	708,760	.87
10	New Jersey	394,767	1.10	10	Pennsylvania	572,346	.70
11	Georgia	321,060	.89	11	Georgia	540,189	.66
12	Missouri	98,414	.27	12	Missouri	218,182	.27
13	Texas	55,966	.16	13	Connecticut and Massachusetts	105,457	.13
14	Kentucky, Maryland, and West Virginia	53,235	.15	14	Kentucky, Maryland, and West Virginia	84,898	.10
15	North Carolina	48,522	.13	15	North Carolina	76,877	.09
16	Connecticut and Massachusetts	28,112	.08	16	Ohio	36,736	.04
17	Ohio	26,585	.07	17	Texas	30,663	.04
18	Colorado	10,176	.03	18	Colorado	18,432	.02
	Total	35,983,336	100.00		Total	81,845,904	100.00

Rank of iron ore producing States in 1908, and 1909, with quantity and value of product and percentage of each—Continued.

1909.

Production.				Value.			
Rank.	State.	Quantity, in long tons.	Percentage of total production.	Rank.	State.	Amount.	Percentage of total value.
1	Minnesota	28,975,149	56.49	1	Minnesota	$60,253,314	54.63
2	Michigan	11,900,384	23.20	2	Michigan	32,282,622	29.27
3	Alabama	4,321,252	8.43	3	Alabama	4,996,455	4.53
4	Wisconsin	1,067,436	2.08	4	New York	3,072,323	2.79
5	New York	1,015,333	1.98	5	Wisconsin	2,727,406	2.47
6	Virginia	837,847	1.63	6	Virginia	1,693,188	1.54
7	Montana, Nevada, New Mexico, Utah, Washington, and Wyoming	766,416	1.50	7	New Jersey	1,607,003	1.46
8	Pennsylvania	666,889	1.30	8	Montana, Nevada, New Mexico, Utah, Washington, and Wyoming	955,775	.87
9	Tennessee	657,795	1.28	9	Tennessee	907,282	.82
10	New Jersey	543,720	1.06	10	Pennsylvania	792,672	.72
11	Georgia	221,016	.43	11	Georgia	332,478	.30
12	Kentucky, Maryland, and West Virginia	98,657	.19	12	Missouri	210,853	.19
13	Missouri	89,954	.18	13	Kentucky, Maryland, and West Virginia	157,073	.14
14	North Carolina	61,150	.12	14	Connecticut and Massachusetts	141,274	.13
15	Connecticut and Massachusetts	38,272	.07	15	North Carolina	107,013	.10
16	Ohio	16,527	.03	16	Ohio	28,547	.02
17	Colorado	10,000	.02	17	Colorado	16,000	.01
18	Texas	6,474	.01	18	Texas	9,318	.01
	Total	51,294,271	100.00		Total	110,290,596	100.00

PRODUCTION OF IRON ORE BY VARIETIES, BY STATES AND MINING DISTRICTS.

Iron minerals are classified as sulphides, oxides, carbonates, silicates, etc., of which only the oxides and carbonates are used in the steel industry. The ores of iron are generally classed under four heads:

1. *Hematite:* Including all the anhydrous sesquioxides (Fe_2O_3—theoretical percentage of iron, 70). This is known locally as red hematite, specular ore, gray ore, fossil ore, oolitic ore, etc.
2. *Brown ore:* Including hydrated sesquioxides, such as limonite, göthite, and turgite ($Fe_2O_3nH_2O$—theoretical percentage of iron, 59.8—66). This is known locally as brown iron ore, brown hematite, bog ore, limonite, etc.
3. *Magnetite:* Including magnetic oxides (Fe_3O_4—theoretical percentage of iron, 72.4). Magnetite is known generally as magnetic iron ore.
4. *Iron carbonate:* Including carbonates of various types ($FeCO_3$—theoretical percentage of iron, 48.2). Iron carbonate is known locally as spathic iron ore, kidney ore, black band ore, siderite, etc.

Hematite has always been predominant as an ore of iron, and at present constitutes almost nine-tenths of the iron ores produced. Brown ore and magnetite are far below it in importance, each furnishing at present about one-twentieth of the total iron-ore production. The production of iron carbonate is insignificant in comparison with that of the other ores, constituting only about one-thirtieth of 1 per cent of the total.

In the following table are shown the quantities of each of the classes of iron ores produced in the various States during 1908 and 1909:

Production of iron ore in the United States in 1908 and 1909, by States and varieties, in long tons.

1908.

State.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total quantity.
Alabama	2,775,903	958,535			3,734,438
Colorado		10,176			10,176
Connecticut and Massachusetts		28,112			28,112
Georgia	1,248	319,812			321,060
Kentucky, Maryland, and West Virginia	7,491	45,744			53,235
Michigan	8,839,199				8,839,199
Minnesota	18,652,220				18,652,220
Missouri	77,400	21,014			98,414
Montana, Nevada, New Mexico, Utah, Washington, and Wyoming	354,012	68,565	95,872		518,449
New Jersey		(a)	[a] 394,767		394,767
New York	33,825		663,648		697,473
North Carolina			48,522		48,522
Ohio				26,585	26,585
Pennsylvania	26,162	73,001	343,998		443,161
Tennessee	226,038	409,305			635,343
Texas		55,966			55,966
Virginia	64,323	626,910	990		692,223
Wisconsin	730,743	3,250			733,993
Total	31,788,564	2,620,390	1,547,797	26,585	35,983,336

1909.

State.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total quantity.
Alabama	3,176,416	1,144,836			4,321,252
Colorado		10,000			10,000
Connecticut and Massachusetts		38,272			38,272
Georgia	9,521	211,495			221,016
Kentucky, Maryland, and West Virginia	45,000	53,657			98,657
Michigan	11,900,384				11,900,384
Minnesota	28,975,149				28,975,149
Missouri	67,391	22,563			89,954
Montana, Nevada, New Mexico, Utah, Washington, and Wyoming	542,744	143,834	79,838		766,416
New Jersey		(a)	[a] 543,720		543,720
New York	53,187		962,146		1,015,333
North Carolina			61,150		61,150
Ohio				16,527	16,527
Pennsylvania	5,144	80,715	581,030		666,889
Tennessee	298,818	358,977			657,795
Texas		6,474			6,474
Virginia	72,955	762,937	1,955		837,847
Wisconsin	1,061,931	5,505			1,067,436
Total	46,208,640	2,839,265	2,229,839	16,527	51,294,271

[a] Brown ore is included in magnetite.

From this table it will be seen that the great bulk of the hematite comes from the Lake Superior district (Michigan, Minnesota, and Wisconsin) and Alabama, the brown ore from the Appalachian States, and the magnetite from New York, New Jersey, and Pennsylvania. All the iron carbonate is obtained from Ohio. On a later page is given the production of the principal ranges in the Lake Superior district. In this report the production is given for the first time of two important southern mining centers, the Birmingham and the Chattanooga districts. In the Birmingham district are included, besides the mines in the immediate vicinity of Birmingham, those in eastern Alabama that ship ores to the furnaces at Birmingham. In the Chattanooga district are included those mines that ship ores to Chattanooga, Tenn., to Rome, Ga., and to Gadsden and Attalla, Ala. The mines near Russellville, Ala., are not included in either district.

Production of iron ore in the United States, by mining districts and varieties, in 1909, in long tons.

District.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
Lake Superior	41,863,635				41,863,635
Birmingham	2,955,246	508,843			3,464,089
Chattanooga	465,494	487,988			953,482
Adirondack	(a)		[a] 869,185		869,185
Northern New Jersey and southeastern New York		(b)	[b] 634,069		634,069
Other	914,001	1,842,434	736,849	16,527	3,509,811
Total	46,198,376	2,839,265	2,240,103	16,527	51,294,271

[a] Hematite is included in magnetite.

[b] Brown ore is included in magnetite.

TOTAL PRODUCTION OF IRON ORE.

In the following table is shown the production of the various types of iron ores in the United States as far as has been recorded. The statistics from 1889 to the present were collected by the United States Geological Survey; those for 1860, 1870, and 1880 were collected for the census reports of those years; those for 1875 and 1881 were estimated by I. L. Bell;[a] and those from 1882 to 1888, inclusive, were estimated by James M. Swank[b] from the pig-iron production. No figures can be obtained for the production of various classes of iron ores prior to 1889, except for the census year 1880.

Production of iron ore in the United States, 1860–1909, in long tons.

Year.	Hematite.	Brown ore.	Magnetite.	Carbonate.	Total.
1860					2,873,460
1870					[c] 3,831,891
1875					4,017,857
1880	2,243,993	1,918,622	2,134,276	823,471	7,120,362
1881					7,119,643
1882					[d] 8,700,000
1883					[d] 8,800,000
1884					[d] 7,718,129
1885					[d] 7,600,000
1886					[d] 10,000,000
1887					[d] 11,300,000
1888					[d] 12,062,530
1889	9,056,288	2,523,087	2,506,415	432,251	14,518,041
1890	10,527,650	2,559,938	2,570,838	377,617	16,036,043
1891	9,327,398	2,757,564	2,317,108	189,108	14,591,178
1892	11,646,619	2,485,101	1,971,965	192,981	16,296,666
1893	8,272,637	1,849,272	1,330,886	134,834	11,587,629
1894	9,347,434	1,472,748	972,219	87,278	11,879,679
1895	12,513,995	2,102,358	1,268,222	73,039	15,957,614
1896	12,576,288	2,126,212	1,211,526	91,423	16,005,449
1897	14,413,318	1,961,954	1,059,479	83,295	17,518,046
1898	16,150,684	1,989,681	1,237,978	55,373	19,433,716
1899	20,004,399	2,869,785	1,727,430	81,559	24,683,173
1900	22,708,274	3,231,089	1,537,551	76,247	27,553,161
1901	24,006,025	3,016,715	1,813,076	51,663	28,887,479
1902	30,532,149	3,305,484	1,688,860	27,642	35,554,135
1903	30,328,654	3,080,399	1,575,422	34,833	35,019,308
1904	23,839,477	2,146,795	1,638,846	19,212	27,644,330
1905	37,567,055	2,546,662	2,390,417	21,999	42,526,133
1906	42,481,375	2,781,063	2,469,294	17,996	47,749,728
1907	46,060,486	2,957,477	2,679,067	23,589	51,720,619
1908	31,788,564	2,620,390	1,547,797	26,585	35,983,336
1909	46,208,640	2,839,265	2,229,839	16,527	51,294,271

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[a] Bell, I. L., Principles of the manufacture of iron and steel, 1884, p. 451.

[b] Mineral Resources U. S., 1882 to 1888.

[c] Includes ore produced by owners of blast furnaces estimated by census at 800,000 tons.

[d] Figures given are for consumption of domestic ores. Total production for 1882, 1883, and 1884 is estimated as 9,000,000, 8,400,000, and 8,200,000 tons, respectively. See Mineral Resources U. S. for 1883 and 1884.

In the following table the production of iron ores in the United States is shown from 1810 to 1869, and by decades from 1870 to 1909. The figures for the years previous to 1889 were calculated from the pig-iron production and include imported ore as well as domestic ore used.

Production of iron ore in the United States from 1810 to 1909, by decades, and rate of increase.

Decade.	Quantity, in long tons.	Percentage of increase.
1810–1869	49,656,000	
1870–1879	43,770,527	
1880–1889	91,043,854	108.0
1890–1899	163,989,193	80.1
1900–1909	383,932,500	134.1

STOCKS OF IRON ORE AT MINES.

Considerable stock was left at the mines at the end of 1909 which is not included in the production. On December 31, 1909, this stock amounted to 6,135,271 tons, as compared with 6,065,397 tons on December 31, 1908. Besides the stock at the mines, stocks are left at receiving ports, but these are included in the annual production.

The following table shows the tonnage of stock left at the mines on December 31, 1908 and 1909, in the various States:

Stock of iron ore on hand at the mines December 31, 1908 and 1909, by States, in long tons.

State.	1908.	1909.
Alabama	381,607	717,153
California		97
Colorado	400	700
Georgia	50,550	46,385
Kentucky	600	400
Maryland		29
Massachusetts	952	711
Michigan	3,280,659	3,186,211
Minnesota	1,737,568	1,678,540
Missouri	10,546	250
New Jersey	115,218	113,773
New York	118,415	247,286
Ohio	15,041	9,802
Pennsylvania	15,781	4,400
Tennessee	26,923	20,357
Texas	53,600	
Utah		100
Vermont	350	
Virginia	8,823	1,000
Washington	15,000	1,000
Wisconsin	233,364	107,077
Total	6,065,397	6,135,271
Percentage of increase in 1909		1.15

PRICE OF IRON ORE PER TON.

In the following table the price per ton of the different classes of iron ores in 1909 is given for each of the producing States. In 1909 the average values were very nearly the same as those of 1908, with the exception of that for the carbonate ore. The total average values per long ton in 1909 were: Hematite, $2.17; brown ore, $1.71; magnetite, $2.40; carbonate, $1.73, as compared with values, respectively, of $2.32, $1.70, $2.40, and $1.38 in 1908. These figures represent the value at the mines and are taken directly from statements of the producers. They should be accepted merely as fair approximation to the truth. The element of inaccuracy arises from the fact that by far the greater bulk of the iron ore produced in the United States is mined by pig-iron producers for their own furnaces, and the value placed on such ore is therefore entirely a matter of accounting. Some of the reports made to the Survey evidently include merely actual mining costs; others contain an allowance for sinking fund; and in still others the figures given are merely convenient prices to use in charging costs against the blast furnaces.

It is to be noted, however, that the errors are almost entirely in one direction—that of undervaluing the ore rather than of overvaluing it. If all the iron ore were to be bought by iron furnaces in open market from an entirely distinct set of iron-ore producers, the average prices paid would probably be considerably in excess of those now reported. It is of interest to compare the prices given below with those of the Lake Superior ores at the lower Lake ports given in a subsequent table.

Average price per long ton of iron ore in the United States in 1909, by States and varieties.

State.	Hematite.	Brown ore.	Magnetite.	Carbonate.
Alabama	$1.07	$1.41		
Colorado		1.60		
Connecticut and Massachusetts		3.69		
Georgia	1.69	1.50		
Kentucky, Maryland, and West Virginia	1.25	1.88		
Michigan	2.71			
Minnesota	2.08			
Missouri	2.49	1.92		
Montana, Nevada, New Mexico, Utah, Washington, and Wyoming	1.00	2.32	$1.00	
New Jersey		2.53	2.96	
New York	1.88		3.09	
North Carolina			1.75	
Ohio				$1.73
Pennsylvania	2.36	2.41	1.01	
Tennessee	1.30	1.45		
Texas		1.44		
Virginia	1.76	2.05	2.00	
Wisconsin	2.56	1.62		
Total average	2.17	1.71	2.40	1.73

APPARENT ANNUAL IRON-ORE CONSUMPTION.

The following table includes data on certain factors from which an approximate estimate of the annual consumption of iron ore in the United States is deduced. The result is of course merely an approximation, for no data are available on certain other factors which should enter into the final result. The elements accounted for in the table and estimate are (1) domestic iron-ore production; (2) stocks of ore at mines for current year and past year; (3) stocks of ore at Lake ports for current year and past year; (4) zinc residuum production; (5) imports of ore; (6) exports of ore.

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Apparent consumption of iron ore in the United States, 1889–1909, in long tons.

Year.	Domestic iron ore produced.	Stocks of ore at mines.	Stocks of ore at lower Lake ports Dec. 1.	Zinc residuum.	Imports.	Exports.	Apparent consumption.
1889	14,518,041	2,256,973	2,607,106	43,648	853,573	....	14,366,562
1890	16,036,043	2,000,000	3,893,487	48,560	1,246,830	....	16,302,025
1891	14,591,178	2,450,279	3,508,489	38,228	912,864	....	15,476,989
1892	16,296,666	2,911,740	4,149,451	31,859	806,585	....	16,032,687
1893	11,587,629	3,526,161	4,070,710	37,512	526,951	....	11,616,412
1894	11,879,679	3,236,198	4,834,247	26,981	167,307	....	11,600,393
1895	15,957,614	2,976,494	4,415,712	43,249	524,153	....	17,203,255
1896	16,005,449	3,405,302	4,954,984	44,953	682,806	....	15,765,128
1897	17,518,046	3,098,287	5,923,755	33,924	489,970	....	17,380,184
1898	19,433,716	2,846,457	5,136,407	48,502	187,208	....	20,708,604
1899	24,683,173	2,320,278	5,530,283	65,010	674,082	40,665	25,513,903
1900	27,553,161	3,709,950	5,904,670	87,110	897,831	51,460	26,722,583
1901	28,887,479	4,239,823	5,859,663	52,311	966,950	64,703	29,357,171
1902	35,554,135	3,834,717	7,074,254	65,246	1,165,470	88,445	35,886,921
1903	35,019,308	6,297,888	6,371,085	73,264	980,440	80,611	34,232,399
1904	27,644,330	4,666,931	5,763,399	68,189	487,613	213,865	30,224,910
1905	42,526,133	3,812,281	6,438,967	90,289	845,651	208,017	43,433,138
1906	47,749,728	3,281,789	6,252,455	93,461	1,060,390	265,240	49,355,343
1907	51,720,619	3,033,110	7,385,728	93,413	1,229,168	278,208	51,880,398
1908	35,983,336	6,065,397	8,441,533	110,225	776,898	309,099	32,473,268
1909	51,294,271	6,135,271	8,965,789	141,264	1,696,411	455,934	52,081,882

COMPARATIVE PRODUCTION OF IRON ORE AND PIG IRON.

Detailed data on the pig-iron production of the United States are presented on later pages of this report, but in the following table an interesting comparison is made between the annual production of iron ore and of pig iron.

Production of iron ore and pig iron in the United States, 1889–1909, in long tons.

Year.	Iron ore mined.	Pig iron produced.[a]	Year.	Iron ore mined.	Pig iron produced.[a]
1889	14,518,041	7,603,642	1900	27,553,161	13,789,242
1890	16,036,043	9,202,703	1901	28,887,479	15,878,354
1891	14,591,178	8,279,870	1902	35,554,135	17,821,307
1892	16,296,666	9,157,000	1903	35,019,308	18,009,252
1893	11,587,629	7,124,502	1904	27,644,330	16,497,033
1894	11,879,679	6,657,388	1905	42,526,133	22,992,380
1895	15,957,614	9,446,308	1906	47,749,728	25,307,191
1896	16,005,449	8,623,127	1907	51,720,619	25,781,361
1897	17,518,046	9,652,680	1908	35,983,336	15,936,018
1898	19,433,716	11,773,934	1909	51,294,271	25,795,471
1899	24,683,173	13,620,703			

[a] From annual reports of the American Iron and Steel Association.

IRON-ORE INDUSTRY IN THE LAKE SUPERIOR DISTRICT.

Production of iron ore in the Lake Superior district, by ranges.—The Lake Superior district includes the Vermilion, Mesabi, Cuyuna, Penokee-Gogebic, Marquette, and Menominee ranges in the States of Minnesota, Michigan, and Wisconsin. The Menominee range includes the Crystal Falls, Metropolitan, Iron River, and Florence areas; the Marquette range includes the Republic and Swanzy areas. The Baraboo and Iron Ridge areas of southern Wisconsin and the Spring Valley area of northwestern Wisconsin are frequently also included in the Lake Superior district. In the first group of ranges the ore mined is almost entirely pre-Cambrian hematite associated with the Lake Superior iron-ore formation. The Baraboo ore is of the same nature, but the Iron Ridge ore is Clinton hematite, and the Spring Valley ore is brown ore.

In addition to these ranges, there are several iron-ore districts on the Canadian side of the Great Lakes, the principal ones of which are the Michipicoten, the Animikie, the Matawin, and the Atikokan.

The American districts which produced ore in 1909 were the Vermilion, Mesabi, Penokee-Gogebic, Marquette, Menominee, Baraboo, and Spring Valley. The following table shows the production of the first five of these for 1908 and 1909, as they constitute the Lake Superior district proper:

Production of iron ore in the Lake Superior region, 1908–9, by ranges.

Range.	1908.	1909.	Increase in 1909.	Percentage of increase in 1909.	Percentage of total production in Lake Superior region.
	Long tons.	*Long tons.*	*Long tons.*		
Marquette (Michigan)	3,309,917	[a] 4,291,967	982,050	29.66	10.25
Menominee (Michigan and Wisconsin)	2,904,011	4,789,362	1,885,351	64.92	11.44
Gogebic (Michigan and Wisconsin)	3,241,931	[a] 3,807,157	565,226	17.43	9.10
Vermilion (Minnesota)	927,206	1,097,444	170,238	18.36	2.62
Mesabi (Minnesota)	17,725,014	27,877,705	10,152,691	57.28	66.59
Total	28,108,079	41,863,635	13,755,556	48.94	100.00

[a] Some Gogebic ore included in Marquette.

The Mesabi range produced 66.59 per cent of the entire Lake Superior output and about 54.3 of the entire production of the United States. The Menominee, Marquette, and Penokee-Gogebic ranges are next in importance, the Menominee producing a little more and the others a little less than the State of Alabama, which is the next State in importance as a producer after Minnesota and Michigan. The Vermilion range, the last in importance of the five producing Lake Superior ranges, produced more ore than New York, which is fifth in importance as a producing State.

In the following table is shown the total production of the Lake Superior district by ranges. The figures prior to 1872 were collected by A. P. Swineford, editor Marquette Mining Journal;[a] those for 1872 to 1877, inclusive, are from the Michigan Mineral Statistics; those from 1878 to 1888, inclusive, were collected by W. J. Stevens;[b] and the later figures were collected by the United States Geological Survey.

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[a] Mineral Resources U. S. for 1882, p. 116.
[b] Mineral Resources U. S. for 1891, p. 41.

Production of Lake Superior iron ore, 1854–1909, by ranges, in long tons.

Year.	Marquette.	Menomi-nee.	Gogebic.	Vermillion.	Mesabi.	Total.
1854–1869	3,112,209					3,112,209
1870	859,507					859,507
1871	813,984					813,984
1872	948,553					948,553
1873	1,195,234					1,195,234
1874	899,934					899,934
1875	881,166					881,166
1876	993,311					993,311
1877	1,014,754	10,375				1,025,129
1878	1,033,082	78,028				1,111,110
1879	1,130,019	245,672				1,375,691
1880	1,384,010	524,735				1,908,745
1881	1,579,834	726,671				2,306,505
1882	1,829,394	1,136,018				2,965,412
1883	1,305,364	1,047,863				2,353,227
1884	1,559,912	895,634	1,022	62,122		2,518,690
1885	1,430,862	690,435	119,590	227,075		2,467,962
1886	1,627,383	880,006	756,237	307,948		3,571,574
1887	1,851,717	1,199,343	1,285,265	394,910		4,731,235
1888	1,918,672	1,191,097	1,433,689	511,953		5,055,411
1889	2,631,026	1,876,157	2,147,923	864,508		7,519,614
1890	2,863,848	2,274,192	2,914,081	891,910		8,944,031
1891	2,778,482	1,856,124	2,041,754	945,105		7,621,465
1892	2,848,552	2,402,195	3,058,176	1,226,220	29,245	9,564,388
1893	2,064,827	1,563,049	1,466,815	815,735	684,194	6,594,620
1894	1,935,379	1,255,255	1,523,451	1,055,229	1,913,234	7,682,548
1895	1,982,080	1,794,970	2,625,475	1,027,103	2,839,350	10,268,978
1896	2,418,846	1,763,235	2,100,398	1,200,907	3,082,973	10,566,359
1897	2,673,785	1,767,220	2,163,088	1,381,278	4,220,151	12,205,522
1898	2,987,930	2,275,664	2,552,205	1,125,538	4,837,971	13,779,308
1899	3,634,596	3,281,422	2,725,648	1,643,984	6,517,305	17,802,955
1900	3,945,068	3,680,738	3,104,033	1,675,949	8,158,450	20,564,238
1901	3,597,089	3,697,408	3,041,869	1,805,996	9,303,541	21,445,903
1902	3,734,712	4,421,250	3,683,792	2,057,532	13,080,118	26,977,404
1903	3,686,214	4,093,320	3,422,341	1,918,584	13,452,812	26,573,271
1904	2,465,448	2,871,130	2,132,898	1,056,430	11,672,405	20,198,311
1905	3,772,645	4,472,630	3,344,551	1,578,626	20,156,566	33,325,018
1906	4,070,914	4,962,357	3,484,023	1,794,186	23,564,891	37,876,371
1907	4,167,810	4,779,592	3,609,519	1,724,217	27,245,441	41,526,579
1908	3,309,917	2,904,011	3,241,931	927,206	17,725,014	28,108,079
1909	4,291,967	4,789,362	3,807,157	1,097,444	27,877,705	41,863,635
Total	93,230,036	71,407,158	61,786,931	29,317,695	196,361,366	452,103,186

Shipments and receipts of Lake Superior ore.—During 1909, 41,683,599 long tons of iron ore were shipped from the Lake Superior district. Of this total 903,270 tons were shipped by rail, the remainder being Lake shipments. Details concerning the shipments and receipts of these ores are given in the following tables, which are taken from the Iron Trade Review:

Shipments of Lake Superior iron ore, 1904–1909, in long tons.[a]

Shipping port.	1904.	1905.	1906.	1907.	1908.	1909.
Two Harbors	4,566,542	7,779,850	8,180,125	8,188,906	5,702,237	9,181,132
Escanaba	3,644,267	5,307,938	5,851,050	5,761,988	3,351,502	5,747,801
Duluth	4,649,611	8,807,559	11,220,218	13,448,736	8,808,168	13,470,503
Ashland	2,288,400	3,485,344	3,388,106	3,436,867	2,513,670	3,834,207
Marquette	1,907,301	2,977,828	2,791,033	3,013,826	1,487,487	2,909,451
Superior	4,169,990	5,118,385	6,083,057	7,440,386	3,564,030	6,540,505
Gladstone	553					
Total	21,226,664	33,476,904	37,513,589	41,290,709	25,427,094	41,683,599
All-rail shipments	622,737	907,212	1,052,173	975,959	587,893	903,270
Grand total	21,849,401	34,384,116	38,565,762	42,266,668	26,014,987	42,586,869

[a] Iron Trade Review.

Iron-ore receipts at Lake Erie ports, 1904–1909, in long tons.[a]

Port.	1904.	1905.	1906.	1907.	1908.	1909.
Ashtabula, Ohio	3,639,250	6,373,779	6,833,352	7,521,859	3,012,064	8,056,941
Cleveland, Ohio	3,572,228	5,854,745	6,604,661	6,495,998	4,240,816	6,051,342
Conneaut, Ohio	4,083,655	5,327,552	5,432,370	6,875,937	4,798,631	7,007,834
Buffalo and Tonawanda, N. Y.	2,433,601	3,774,928	4,928,331	5,580,438	2,835,099	5,002,235
Erie, Pa	1,284,778	2,112,476	1,986,539	2,294,239	828,602	1,235,057
Fairport, Ohio	1,157,858	2,008,621	1,861,498	2,437,649	1,518,961	1,734,277
Toledo, Ohio	508,793	1,006,855	1,423,741	1,314,140	680,553	1,374,224
Lorain, Ohio	972,931	1,605,823	2,191,965	2,621,025	2,286,388	2,796,856
Huron, Ohio	231,364	825,278	778,453	971,430	213,377	243,082
Sandusky, Ohio	48,356	51,202	35,847	83,043	....	11,088
Total	17,932,814	28,941,259	32,076,757	35,195,758	20,414,491	33,512,936

[a] Iron Trade Review.

The following table shows the total quantity of iron ore shipped from the Lake Superior district since 1854, the date of the opening of the Marquette range, the oldest of the Lake Superior ranges. This table gives the shipments as collected by the Iron Trade Review and is inserted for comparison with the table giving the total production of the Lake Superior district, without regard to shipments:

Shipments of iron ore from the Lake Superior region, 1854–1909, in long tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1854	3,000	1874	919,557	1894	7,748,932
1855	1,449	1875	891,257	1895	10,429,037
1856	36,343	1876	992,764	1896	9,934,828
1857	25,646	1877	1,015,087	1897	12,469,638
1858	15,876	1878	1,111,110	1898	14,024,673
1859	68,832	1879	1,375,691	1899	18,251,804
1860	114,401	1880	1,908,745	1900	19,059,393
1861	49,909	1881	2,306,505	1901	20,589,237
1862	124,169	1882	2,965,412	1902	27,571,121
1863	203,055	1883	2,353,288	1903	24,289,878
1864	243,127	1884	2,518,692	1904	21,822,839
1865	236,208	1885	2,466,372	1905	34,384,116
1866	278,796	1886	3,568,022	1906	38,565,762
1867	473,567	1887	4,730,577	1907	42,266,668
1868	491,449	1888	5,063,693	1908	26,014,987
1869	617,444	1889	7,292,754	1909	42,586,869
1870	830,940	1890	9,012,379		
1871	779,607	1891	7,062,233	Total	449,351,145
1872	900,901	1892	9,069,556		
1873	1,162,458	1893	6,060,492		

Stocks of iron ore at Lake Erie ports.—At the close of navigation in 1909 the stocks of iron ore at the Lake Erie ports exceeded those of the same date in 1908 by 524,256 tons; and the stocks of 1908 exceeded those of 1907 by more than 1,000,000 tons.

The following statistics from the Iron Trade Review contain data as to the stocks of iron ore at the Lake Erie ports at the close of navigation and at the opening of navigation for the last six years:

Stocks of iron ore at lower Lake ports, December 1, 1904–1909, in long tons.[a]

Port.	At close of navigation, December 1—					
	1904.	1905.	1906.	1907.	1908.	1909.
Ashtabula, Ohio	1,403,575	1,589,951	1,631,312	2,056,820	2,293,531	2,594,359
Cleveland, Ohio	1,237,033	1,330,619	1,224,606	1,281,335	1,458,392	1,547,142
Fairport, Ohio	660,420	759,961	590,783	523,981	835,821	867,640
Erie, Pa	583,439	564,961	552,631	652,219	730,530	788,046
Lorain, Ohio	299,504	271,695	336,321	366,271	426,274	407,129
Conneaut, Ohio	684,487	976,976	1,057,424	1,090,774	1,296,675	1,411,002
Toledo, Ohio	318,573	368,024	281,000	518,645	590,925	332,456
Huron, Ohio	182,495	208,023	245,499	415,730	458,158	477,333
Buffalo, N. Y	318,739	315,780	315,412	435,407	315,148	501,125
Sandusky, Ohio	75,134	52,977	17,467	44,546	36,079	39,557
Total	5,763,399	6,438,967	6,252,455	7,385,728	8,441,533	8,965,789

[a] Iron Trade Review, May 13, 1909, and May 12, 1910.

Stocks of iron ore at lower Lake ports, May 1, 1905–1910, in long tons.[a]

Port.	At opening of navigation, May 1—					
	1905.	1906.	1907.	1908.	1909.	1910.
Ashtabula, Ohio	623,451	462,564	568,485	1,799,454	1,392,430	1,609,931
Cleveland, Ohio	513,559	350,382	447,573	1,029,198	1,018,055	985,725
Fairport, Ohio	390,869	266,162	154,246	225,328	562,679	541,299
Erie, Pa	236,414	169,488	189,276	595,660	557,029	550,187
Lorain, Ohio	165,586	140,452	176,300	327,052	362,096	205,445
Conneaut, Ohio	96,295	148,528	139,853	462,392	497,203	461,365
Toledo, Ohio	71,642	52,550	147,397	217,788	380,675	366,631
Huron, Ohio	68,100	80,738	98,106	392,731	379,364	336,693
Buffalo, N. Y	61,271	90,906	50,313	388,441	189,209	364,336
Sandusky, Ohio	44,444	29,320	5,439	42,256	31,528	22,468
Total	2,271,631	1,791,090	1,976,988	6,480,300	5,370,268	5,444,080

[a] Iron Trade Review, May 13, 1909, and May 12, 1910.

Prices of Lake Superior iron ores.—In the following table are given the prices of Lake Superior iron ores at the lower Lake ports during 1908 and 1909.

The base for the Bessemer ores is a metallic iron content of 55 per cent; that of the non-Bessemer ores is a metallic iron content of 51.5 per cent.

Prices per long ton of Lake Superior iron ores at lower Lake ports, 1908–9.

	1908.		1909.
	Until June 15.	After June 15.	
Old Range:			
Bessemer	$5.00	$4.50	$4.50
Non-Bessemer	4.20	3.70	3.70
Mesabi:			
Bessemer	4.75	4.25	4.25
Non-Bessemer	4.00	3.50	3.50

FOREIGN TRADE IN IRON ORE.

IMPORTS.

The quantity of iron ore imported into the United States in 1909 exceeded the imports of any year heretofore recorded. The imports of 1909 exceeded those of 1908 by more than 118 per cent. Part of this increase was due to the lowering of the tariff on foreign ores from 40 cents per ton to 15 cents per ton, according to the Payne-Aldrich bill, which became a law on August 5, 1909. About 54.7 per cent of the imports were from Cuba, about 17.3 per cent from Spain, about 7 per cent from Sweden, and the bulk of the rest was from Newfoundland, the imports from which increased nearly 365 per cent over those of 1908. The statistics with regard to imports are furnished by the Bureau of Statistics of the Department of Commerce and Labor.

In the following table are shown the imports of iron ore from the various countries from 1906 to 1909, inclusive:

Quantity and value of iron ore imported into the United States in the calendar years 1906–1909, by countries, in long tons.

Country.	1906.		1907.		1908.		1909.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Cuba	639,362	$2,178,997	657,133	$2,522,710	579,668	$1,756,091	927,774	$2,681,028
Spain	171,870	418,922	296,318	760,801	126,074	331,070	291,547	664,460
French Africa	....	....	65,940	252,897	....	....	37,208	67,515
Greece	48,630	61,560	23,800	42,927	4,850	5,311	19,080	21,782
Newfoundland and Labrador	[a] 125,395	125,395	89,685	97,735	48,285	48,285	224,395	330,056
United Kingdom	231	1,955	5,765	16,491	2,028	32,027	869	12,846
Germany	1,084	8,949	273	2,096	602	4,052	3	100
Netherlands	50	474	500	3,673	....	....	....	....
Canada	57,890	100,125	26,878	51,328	5,013	16,321	27,155	84,613
Belgium	400	6,662	125	1,102	1	28	3	179
Norway	9,278	37,240	....	....	....	....	....	....
Russia in Europe	....	....	....	....	....	....	32,010	62,418
Sweden	....	....	....	....	4,617	15,783	120,564	627,315
East Indies—British India	6,200	27,155	....	....	....	....	....	....
Other countries	....	....	62,751	185,723	5,760	15,280	[b] 14,349	26,766
Total	1,060,390	2,967,434	1,229,168	3,937,483	776,898	2,224,248	1,694,957	4,579,078

[a] Newfoundland only.

[b] Other countries in 1909: Colombia and Mexico.

The following table shows the imports of iron ore into the United States from 1906 to 1909, inclusive, by ports of entry:

Quantity and value of iron ore imported into the United States in the calendar years 1906–1909, by customs districts, in long tons.

Customs district.	1906.		1907.		1908.		1909.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Baltimore	617,866	$1,937,610	639,602	$2,436,457	248,875	$844,436	628,577	$1,838,762
Boston	159	1,218	479	2,071	21	61	7	29
Charleston	....	....	500	3,673	500	3,070	....	....
Fernandina	50	474	....	....	....	....	....	....
New York	3,475	8,400	7,405	19,989	4,392	17,424	47,285	93,277
Perth Amboy	290	1,450	....	....	1,355	23,637	....	....
Philadelphia	383,651	914,242	554,104	1,422,503	516,619	1,318,182	991,983	2,559,760
Savannah	....	....	100	630	....	....	....	....
Alaska	3	6	....	....	....	....	....	....
Los Angeles	859	6,940	....	....	51	501	....	....
Pugot Sound	9	77	1,976	6,365	....	....	....	....
San Francisco	100	925	100	832	50	446	....	....
Buffalo Creek	124	280	172	96	....	....	141	489
Champlain	55	140	5	20	10	30	40	75
Cuyahoga	46,630	83,418	18,866	33,393	1,712	3,030	3,500	15,250
Detroit	4,863	8,007	....	....	....	....	25	777
Erie	2,162	3,827	5,400	9,558	....	....	4,000	16,700
Miami	....	....	....	....	2,569	9,403	18,106	46,106
Niagara	....	....	292	652	23	40	596	2,310
Oswegatchie	41	42	....	....	23	60	....	....
Vermont	53	378	167	1,244	676	3,758	455	2,054
St. Louis	....	....	....	....	22	170	....	....
Genesee	....	....	....	....	....	....	17	895
Other districts	....	....	....	....	....	....	225	2,594
Total	1,060,390	2,967,434	1,229,168	3,937,483	776,898	2,224,248	1,694,957	4,579,078

In the following table is shown the importation of iron ore into the United States as far as has been recorded. Iron ore was imported from Europe in large quantities for the first time in 1879, most of the ore prior to that date coming from Canada.

Imports of iron ore into the United States, 1872–1909, in long tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1872	23,733	1884	487,820	1897	489,970
1873	45,981	1885	390,786	1898	187,208
1874	57,987	1886	1,039,433	1899	674,082
1875	56,655	1887	1,194,301	1900	897,831
1876	17,284	1888	587,470	1901	966,950
1877	30,669	1889	853,573	1902	1,165,470
1878	28,212	1890	1,246,830	1903	980,440
1879[a]	150,197	1891	912,864	1904	487,613
1879[b]	284,141	1892	806,585	1905	845,651
1880	493,408	1893	526,951	1906	1,060,390
1881	782,887	1894	167,307	1907	1,229,168
1882	589,655	1895	524,153	1908	776,898
1883	490,875	1896	682,806	1909	1,694,957

[a] Fiscal years end.

[b] Calendar years begin.

EXPORTS.

The quantity of iron ore exported from the United States in 1909 amounted to 455,934 long tons, an increase of more than 47 per cent over iron-ore exports in 1908.

In the following table is shown the exportation of iron ores from the United States by customs districts from 1906 to 1909, inclusive. The data regarding exports are collected by the Bureau of Statistics, Department of Commerce and Labor.

Quantity and value of iron ore exported from the United States, 1906–1909, by customs districts, in long tons.

Customs district.	1906.		1907.		1908.		1909.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Newport News	171	$940	77	$419				
New York	115	930						
Norfolk and Portsmouth			18	240			3	$27
Arizona			206	1,098				
Buffalo Creek					25	$140	336	1,506
Champlain	15,226	45,692	14,855	44,595	7,359	22,517	9,417	27,170
Detroit			4	47	4	46		
Duluth	165,780	561,316	43,513	150,722	52,509	187,059	129,231	471,088
Huron	28	169						
Memphremagog	43	143						
Niagara			60	195	3,097	7,289	6,887	21,819
Superior	83,877	162,649	219,761	565,644	244,408	789,306	306,270	830,415
Vermont			114	462	1,697	6,567		
Puget Sound							3,790	13,300
Total	265,240	771,839	278,608	763,422	309,099	1,012,924	455,934	1,365,325

The quantity of iron ore exported from the United States, as far as has been recorded, is shown in the following table:

Exports of iron ore from the United States, 1899 to 1909, in long tons.

Year.	Quantity.	Year.	Quantity.
1899	40,665	1905	208,017
1900	51,460	1906	265,240
1901	64,703	1907	278,208
1902	88,445	1908	309,099
1903	80,611	1909	455,934
1904	213,865		

IRON-ORE INDUSTRY OF CUBA.

The iron ores which have been mined in Cuba up to the present time consist largely of hematite and magnetite and are obtained near Santiago, in the province of Oriente (Santiago). Recently large deposits of brown ore have been attracting considerable attention, especially those of the Mayari and Moa fields in Oriente Province and those of the Cubitas field in Camaguey Province. No ores of this type were reported as mined in 1909, but there was a considerable production in 1910.

The following table shows the shipments of iron ore from Cuba since the opening of the mines in 1884. The statistics of the Cuban iron-ore production were collected by the United States Geological Survey.

Shipments of iron ore from mines in the province of Oriente (Santiago), 1884–1909, in long tons.

Year.	Juragua Iron Co. (Limited).	Sigua Iron Co.	Spanish-American Iron Co.	Cuban Steel Ore Co.	Ponupo Manganese Co.	Total.
1884	25,295					25,295
1885	80,716					80,716
1886	112,074					112,074
1887	94,240					94,240
1888	206,061					206,061
1889	260,291					260,291
1890	363,842					363,842
1891	264,262					264,262
1892	335,236	6,418				341,654
1893	337,155	14,020				351,175
1894	156,826					156,826
1895	307,503		74,991			382.494
1896	298,885		114,110			412,995
1897	[a] 248,256		[b] 206,029			454,285
1898	83,696		84,643			168,339
1899	161,783		215,406			377,189
1900	154,871		292,001			446,872
1901	199,764		[c] 334,833	17,651		552,248
1902	221,039		455,105	23,590		699,734
1903	155,898		467,723			623,621
1904	31,162		356,111			387,273
1905	139,828		421,331			561,159
1906	133,379		507,195			640,574
1907	181,063		500,330			681,393
1908	366,580		452,854			819,434
1909	356,659		514,066		59,721	930,446

[a] Of this quantity, 5,932 tons were sent to Pictou, Nova Scotia.
[b] Of this quantity, 51,537 tons were sent to foreign ports.
[c] Of this quantity, 12,691 tons were sent to foreign ports.

WORLD'S PRODUCTION OF IRON ORE.

The latest available statistics with regard to the world's production of iron ore are shown in the following table. Of the figures in this table, those of the United States, Great Britain, Cuba, Canada, India, and Australia are in long tons; those of the other countries are in metric tons.

World's production of iron ore in 1907 and 1908, by countries.

Country.	1907.	1908.
	Tons.	*Tons.*
United States	51,720,619	35,983,336
Germany and Luxemburg	27,697,128	24,278,151
United Kingdom	15,731,604	15,031,025
Spain	9,896,178	9,271,592
France	10,008,478	10,057,145
Russia	5,700,000	(a)
Sweden	4,480,070	4,713,160
Austria-Hungary	4,356,804	4,718,700
Canada, Newfoundland	887,321	[b] 935,154
Cuba	819,434	930,446
Algeria	973,445	943,424
Greece	768,863	615,368
Italy	517,952	539,120
Belgium	316,250	188,780
China [c]	105,489	133,458
India	67,839	59,224
Japan	(a)	(a)
Norway	140,804	119,656
Australia	3,000	55,194

[a] Not available.
[b] Newfoundland only.
[c] Exports.

IRON AND STEEL INDUSTRY OF THE UNITED STATES.[a]

PRODUCTION OF PIG IRON BY STATES.

During 1909 the production of pig iron amounted to 25,795,471 long tons, as compared with 15,936,018 long tons in 1908 and with 25,781,361 long tons in 1907. The 1909 production was greater than that of any year heretofore recorded.

In the following table the pig-iron production of the United States is given, by States, for 1907, 1908, and 1909:

Production of pig iron, 1907–1909, by States.

State.	Blast furnaces.				Production, including spiegeleisen and ferromanganese, in long tons.		
	In blast June 30, 1909.	December 31, 1909.			1907.	1908.	1909.
		In.	Out.	Total.			
Pennsylvania	103	134	28	162	11,348,549	6,987,191	10,918,824
Ohio	44	61	13	74	5,250,687	2,861,325	5,551,545
Illinois	19	23	3	26	2,457,768	1,691,944	2,467,156
Alabama	19	29	22	51	1,686,674	1,397,014	1,763,617
New York	15	17	11	28	1,659,752	1,019,495	1,733,675
Virginia	9	13	13	26	478,771	320,458	391,134
Tennessee	9	13	8	21	393,106	290,826	333,845
Colorado	3	3	3	6	468,486	313,071	382,766
Missouri	2	2	0	2			
Oregon	0	0	1	1			
Washington	0	0	1	1			
California	0	0	0	0			
Maryland	3	4	1	5	411,833	183,502	286,856
New Jersey	3	5	6	11	373,189	225,372	294,474
Wisconsin	5	6	1	7	322,083	148,938	348,177
Minnesota	1	1	0	1			
Indiana	5	7	0	7	436,507	348,096	964,289
Michigan	7	11	4	15			
West Virginia	3	3	1	4	291,066	65,551	228,282
Kentucky	3	2	6	8	127,946	45,096	86,371
Georgia	1	0	4	4	55,825	24,345	26,072
Texas	0	0	4	4			
Connecticut	3	2	1	3	19,119	13,794	18,388
Massachusetts	1	2	0	2			
Total	258	338	131	469	25,781,361	15,936,018	25,795,471

The accompanying diagram (fig. 2) illustrates the course of the manufacture of pig iron, by months, in 1907, 1908, and 1909. The sudden decline in production of pig iron at the close of October, 1907, the low production during the first half of 1908, the slow recovery of activity in the last half of 1908, the hesitating conditions early in 1909, and finally the steady and rapid increase in production during the last part of the year, the month of December leading with a record production of more than 2,682,000 tons, are all strikingly displayed.

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[a] The pig iron and steel statistics in the following pages were collected and published by James M. Swank, general manager of the American Iron and Steel Association, in his annual statistical reports.

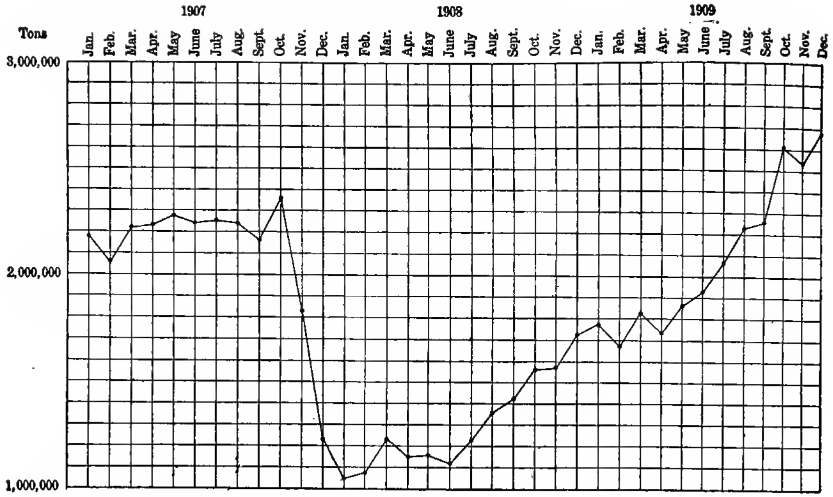

FIGURE 2.—Curve showing production of pig iron in the United States in 1907, 1908, and 1909, by months.

[Tonnage by months according to the Iron Trade Review, January 6, 1910.]

PRODUCTION OF PIG IRON BY GRADES.

The following table shows the production of different grades of pig iron from 1905 to 1909:

Production of pig iron in the United States, 1905–1909, by grades, in long tons.

Grade.	1905.	1906.	1907.	1908.	1909.
Bessemer and low phosphorus	12,407,116	13,840,518	13,231,620	7,216,976	10,557,370
Basic (mineral fuel)	4,105,179	5,018,674	5,375,219	4,010,144	8,250,225
Forge pig iron	727,817	597,420	683,167	457,164	725,624
Foundry and ferrosilicon	4,758,038	4,773,011	5,151,209	3,637,622	5,322,415
Malleable Bessemer	635,236	699,701	920,290	414,957	658,048
Spiegeleisen	227,797	244,980	283,430	111,376	142,831
Ferromanganese	62,186	55,520	55,918	40,642	82,209
White, mottled, direct castings, etc	69,011	77,367	80,508	47,137	56,749
Total	22,992,380	26,307,191	25,781,361	15,936,018	25,795,471

PRODUCTION OF PIG IRON ACCORDING TO FUEL USED.

In the following table is given the production of pig iron according to the fuel used from 1905 to 1909, inclusive:

Production of pig iron according to fuel used, 1905–1909, in long tons.

Fuel used.	1905.	1906.	1907.	1908.	1909.
Bituminous, chiefly coke	20,964,937	23,313,498	23,972,410	15,331,863	24,721,037
Anthracite and coke	1,644,424	1,635,614	1,335,286	353,315	682,383
Anthracite alone	30,091	25,072	36,268	1,694	16,048
Charcoal	352,928	433,007	437,397	249,146	376,003
Total	22,992,380	25,307,191	26,781,361	15,936,018	25,795,471

TOTAL PRODUCTION OF PIG IRON.

The following table shows the production of pig iron in the United States as far as has been recorded. The statistics for 1854 and all succeeding years were collected by the American Iron and Steel Association; those for 1810, 1840, and 1850 are census figures; those for the other years are largely estimates by early statisticians.

Production of pig iron in the United States, 1810–1909, in long tons.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
1810	53,908	1863	846,075	1887	6,417,148
1820	20,000	1864	1,014,282	1888	6,489,738
1828	130,000	1865	831,770	1889	7,603,642
1829	142,000	1866	1,205,663	1890	9,202,703
1830	165,000	1867	1,305,023	1891	8,279,870
1831	191,000	1868	1,431,250	1892	9,157,000
1832	200,000	1869	1,711,287	1893	7,124,502
1840	286,903	1870	1,665,179	1894	6,657,388
1842	215,000	1871	1,706,793	1895	9,446,308
1846	765,000	1872	2,548,713	1896	8,623,127
1847	800,000	1873	2,560,963	1897	9,652,680
1848	800,000	1874	2,401,262	1898	11,773,934
1849	650,000	1875	2,023,733	1899	13,620,703
1850	563,755	1876	1,868,961	1900	13,789,242
1852	500,000	1877	2,066,594	1901	15,878,354
1854	657,337	1878	2,301,215	1902	17,821,307
1855	700,159	1879	2,741,853	1903	18,009,252
1856	788,515	1880	3,835,191	1904	16,497,033
1857	712,640	1881	4,144,254	1905	22,992,380
1858	629,548	1882	4,623,323	1906	25,307,191
1859	750,560	1883	4,595,510	1907	25,781,361
1860	821,223	1884	4,097,868	1908	15,936,018
1861	653,164	1885	4,044,526	1909	25,795,471
1862	703,270	1886	5,683,329		

PRICES OF PIG IRON.

In the following table are given the average monthly prices of the principal kinds of pig iron for 1908 and 1909:

Average monthly prices per ton of pig iron, 1908 and 1909, by months and kinds.

Month.	1908.				1909.			
	No. 2 foundry pig iron at Pittsburg.	Gray forge pig iron at Pittsburg.	Bessemer pig iron at Pittsburg.	Basic pig iron at Philadelphia.	No. 2 foundry pig iron at Pittsburg.	Gray forge pig iron at Pittsburg.	Bessemer pig iron at Pittsburg.	Basic pig iron at Philadelphia.
January	$17.90	$17.00	$19.00	$17.10	$16.28	$15.40	$17.34	$16.75
February	16.90	15.99	17.90	17.25	15.90	15.09	16.77	16.56
March	16.90	15.90	17.86	17.25	15.62	14.65	16.34	15.75
April	16.40	15.45	17.49	17.25	15.06	14.40	15.80	15.00
May	15.90	14.90	16.96	16.37	15.08	14.40	15.84	15.12
June	15.90	14.90	16.90	15.50	15.63	14.77	16.02	15.50
July	15.90	14.90	16.83	15.10	15.96	14.85	16.40	15.80
August	15.65	14.71	16.26	15.00	16.20	15.21	17.02	17.06
September	15.40	14.46	15.90	15.44	17.03	16.15	18.05	18.10
October	15.40	14.40	15.75	15.80	18.02	17.02	19.52	18.37
November	16.40	14.90	16.59	16.19	18.09	17.27	19.90	18.81
December	16.65	15.25	17.40	16.70	17.90	17.40	19.90	18.75

PRODUCTION OF STEEL BY STATES AND KINDS.

The year 1908 marked an epoch in steel making, as during this year the production of open-hearth steel passed that of Bessemer steel.

The records of the year 1909 show that, although the production of Bessemer steel greatly surpassed that of 1908, the decline in the output of this variety of steel apparently has begun, for it fell below that of any other year since 1904.

The following table shows the production of Bessemer steel ingots and castings in the leading States from 1905 to 1909, inclusive:

Production of Bessemer ingots and castings, 1905–1909, by States, in long tons.

State.	1905.	1906.	1907.	1908.	1909.
Pennsylvania	4,491,445	4,827,725	4,351,841	2,106,382	2,845,602
Ohio	3,131,149	3,769,913	3,636,679	1,955,446	3,466,077
Illinois	1,651,250	1,684,772	1,723,073	1,237,747	1,632,444
Other States	1,667,531	1,993,420	1,955,956	817,180	1,386,660
Total	10,941,375	12,275,830	11,667,549	6,116,755	9,330,783

In the following table is given the production of open-hearth steel ingots and castings in the leading States from 1905 to 1909, inclusive:

Production of open-hearth steel ingots and castings, 1905–1909, by States, in long tons.

State.	1905.	1906.	1907.	1908.	1909.
New England	239,282	251,047	239,797	158,417	257,392
New York and New Jersey	348,072	553,186	706,019	350,348	618,117
Pennsylvania	6,471,818	7,718,213	7,868,353	5,322,229	9,400,287
Illinois	617,625	884,472	1,013,251	483,104	1,052,572
Ohio	687,392	818,683	819,642	525,171	1,424,452
Other States	607,187	754,812	902,674	997,460	1,741,116
Total	8;971,376	10,980,413	11,549,736	7,836,729	14,493,936

The following table gives the production, by States, of basic and acid open-hearth steel ingots and castings in 1909:

Production of basic and acid open-hearth steel ingots and castings in 1909, by States, in long tons.

State.	Basic open-hearth steel.	Acid open-hearth steel.	Total.
New England	198,522	58,870	257,392
New York and New Jersey	547,282	70,835	618,117
Pennsylvania	8,624,189	776,098	9,400,287
Illinois	1,039,247	13,325	1,052,572
Ohio	1,345,994	78,458	1,424,452
Other States	1,662,238	78,878	1,741,116
Total	13,417,472	1,076,464	14,493,936

The following table gives the production of all kinds of steel ingots and castings in 1908 and 1909:

Production of all kinds of steel ingots and castings in 1908 and 1909, by States, in long tons.

State.	1908.				1909.			
	Bessemer.	Open-hearth.	Crucible and all other.	Total ingots and castings.	Bessemer.	Open-hearth.	Crucible and all other.	Total ingots and castings.
Massachusetts, Rhode Island, and Connecticut	837	158,417	3,344	162,598	1,174	257,392	3,562	262,128
New York and New Jersey	351,794	350,348	19,911	722,053	602,046	618,117	34,930	1,255,093
Pennsylvania	2,106,382	5,322,229	37,254	7,465,865	2,845,602	9,400,287	63,900	12,309,789
Delaware, Maryland, District of Columbia, Virginia, West Virginia, Kentucky, Georgia, and Alabama[a]	375,756	499,096	....	874,852	751,921	512,650	70	1,264,641
Ohio	1,955,446	525,171	1,172	2,481,789	3,466,077	1,424,452	2,145	4,892,674
Indiana and Illinois	1,237,747	650,403	4,736	1,892,886	1,632,444	1,836,529	19,704	3,488,677
Other States	88,793	331,065	3,346	423,204	31,519	444,509	5,991	482,019
Total	6,116,755	7,836,729	69,763	14,023,247	9,330,783	14,493,936	130,302	23,955,021

[a] 1909 figures include Louisiana and Texas.

TOTAL PRODUCTION OF STEEL.

The statistics of the production of various kinds of steel, so far as has been recorded, are given in the following table. The first steel produced in this country was probably made in Connecticut in 1728 by Samuel Higley and Joseph Dewey. Crucible steel was first successfully produced in the United States in 1832 at the works of William and John H. Garrard, at Cincinnati, Ohio. Bessemer steel was first made in this country in September, 1864, by William F. Durfee at an experimental plant at Wyandotte, Mich., and open-hearth steel in 1864 by the New Jersey Steel and Iron Company at Trenton, N. J.

Production of steel in the United States, 1810–1909, in long tons.

Year.	Bessemer.	Open-hearth.	Crucible.	Other steel.	Total.
1810	....	....	917		917
1860	....	....	11,838		11,838
1863	....	....	8,075		8.075
1864	....	....	9,258		9,258
1865	....	....	13,627		13.627
1866	....	....	16,940		16,940
1867	2,679	....	16,964		19.643
1868	7,589	....	19,197		26,786
1869	10,714	893	19,643		31,250
1870	37,500	1,339	29,911		68,750
1871	40,179	1,785	31,250		73.214
1872	107,239	2,679	26,125	6,911	142,954
1873	152,368	3,125	31,059	12,244	198,796
1874	171,369	6,250	32,436	5,672	215,727
1875	335,283	8,080	35,180	11,256	389,799
1876	469,639	19,187	35,163	9,202	533,191
1877	500,524	22,349	36,098	10,647	569,618
1878	653,773	32,255	38,309	7,640	731,977
1879	829,439	50,259	50,696	4,879	935,273
1880	1,074,262	100,851	64,664	7,558	1,247,335
1881	1,374,247	131,202	80,145	2,720	1,588,314

Production of steel in the United States, 1810–1909, in long tons—Continued.

Years.	Bessemer.	Open-hearth.	Crucible.	Other steel.	Total.
1882	1,514,687	143,341	75,973	2,691	1,736,692
1883	1,477,345	119,356	71,835	4,999	1,673,535
1884	1,375,531	117,515	53,270	4,563	1,550,879
1885	1,519,430	133,376	57,599	1,515	1,711,920
1886	2,269,190	218,973	71,973	2,367	2,562,503
1887	2,936,033	322,069	75,375	5,594	3,339,071
1888	2,511,161	314,318	70,279	3,682	2,899,440
1889	2,930,204	374,543	75,865	5,120	3,385,732
1890	3,688,871	513,232	71,175	3,793	4,277,071
1891	3,247,417	579,753	72,586	4,484	3,904,240
1892	4,168,435	669,889	84,709	4,548	4,927,581
1893	3,215,686	737,890	63,613	2,806	4,019,995
1894	3,571,313	784,936	51,702	4,081	4,412,032
1895	4,909,128	1,137,182	67,666	858	6,114,834
1896	3,919,906	1,298,700	60,689	2,394	5,281,689
1897	5,475,315	1,608,671	69,959	3,012	7,156,957
1898	6,609,017	2,230,292	89,747	3,801	8,932,857
1899	7,586,354	2,947,316	101,213	4,974	10,639,857
1900	6,684,770	3,398,135	100,562	4,862	10,188,329
1901	8,713,302	4,656,309	98,513	5,471	13,473,595
1902	9,138,363	5,687,729	112,772	8,386	14,947,250
1903	8,592,829	5,829,911	102,434	9,804	14.534,978
1904	7,859,140	5,908,166	83,391	9,190	13,859,887
1905	10,941,375	8,971,376	102,233	8,963	20,023.947
1906	12,275,830	10,980,413	127,513	14,380	23,398.136
1907	11,667,549	11,549,736	131,234	14,075	23,362,594
1908	6,116,755	7,836,729	63,631	6,132	14,023,247
1909	9,330,783	14,493,936	107,355	22,947	23,955,021

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Production of steel in the United States, 1810-1909, in long tons—Continued.

Years.	Bessemer.	Open-hearth.	Crucible.	Other steel.	Total.
1882	1,514,687	143,341	75,973	2,691	1,736,692
1883	1,477,345	119,356	71,835	4,999	1,673,535
1884	1,375,531	117,515	53,270	4,563	1,550,879
1885	1,519,430	133,376	57,599	1,515	1,711,920
1886	2,269,190	218,973	71,973	2,367	2,562,503
1887	2,936,033	322,069	75,375	5,594	3,339,071
1888	2,511,161	314,318	70,279	3,682	2,899,440
1889	2,930,204	374,543	75,865	5,120	3,385,732
1890	3,688,871	513,232	71,175	3,793	4,277,071
1891	3,247,417	579,753	72,586	4,484	3,904,240
1892	4,168,435	669,889	84,709	4,548	4,927,581
1893	3,215,686	737,890	63,613	2,806	4,019,995
1894	3,571,313	784,936	51,702	4,081	4,412,032
1895	4,909,128	1,137,182	67,666	858	6,114,834
1896	3,919,906	1,298,700	60,689	2,394	5,281,689
1897	5,475,315	1,608,671	69,959	3,012	7,156,957
1898	6,609,017	2,230,292	89,747	3,801	8,932,857
1899	7,586,354	2,947,316	101,213	4,974	10,639,857
1900	6,684,770	3,398,135	100,562	4,862	10,188,329
1901	8,713,302	4,656,309	98,513	5,471	13,473,595
1902	9,138,363	5,687,729	112,772	8,386	14,947,250
1903	8,592,829	5,829,911	102,434	9,804	14.534,978
1904	7,859,140	5,908,166	83,391	9,190	13,859,887
1905	10,941,375	8,971,376	102,233	8,963	20.023.947
1906	12,275,830	10,980,413	127,513	14,380	23,398.136
1907	11,667,549	11,549,736	131,234	14,075	23,362,594
1908	6,116,755	7,836,729	63,631	6,132	14,023,247
1909	9,330,783	14,493,936	107,355	22,947	23,955,021

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[a] Numbers of folios containing important articles on iron ores are printed in italics.

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STATISTICS OF THE AMERICAN IRON TRADE FOR 1904.

By James M. Swank,
General Manager of the American Iron and Steel Association.

BRIEF REVIEW OF THE AMERICAN IRON TRADE IN 1904.

The reaction in general business conditions in this country which began in the first half of 1903 continued until August and September of 1904, when unmistakable signs of the end of the reaction were visible on every hand. In October business confidence was entirely reestablished. Before the close of this month railroad and industrial stocks had greatly advanced in price and the manufacturing industries of the country were again as active as if nothing had happened to interrupt their prosperity. The railroads were busy moving the good crops of the year and the products of our mines, forests, and manufacturing establishments. This favorable condition of business continued all through the winter, notwithstanding its exceptional severity, and has been continued without abatement through the spring months of the present year. In April railroad and other stocks reached still higher figures than during the preceding fall and winter. Prices of farm products have continued in the main to be satisfactory to the farmers.

The improvement in general trade conditions noted above has particularly affected the iron trade, so much so that for several months the demand for iron and steel products in this country has never been equaled. It has taxed and is still taxing our manufacturing plants to their utmost available capacity. This extraordinary activity is probably of more general application to all branches of the iron trade than any similar demand in other years. Certainly American manufacturers of pig iron, steel rails, structural steel, plates and sheets, cars and locomotives (including railroad shops), and general machinery and foundry products were never more actively employed than they are to-day. The whole country urgently wants iron and steel for a thousand uses. The export trade in some iron and steel branches is also contributing to the general activity. But the greatest demand for iron and steel comes from the railroads. The fact is now generally recognized that railroad managers have not kept abreast of the country's marvelous industrial development in the last few years. More tracks, more cars, and more locomotives have been needed than had been built, and also more bridges and better terminal facilities. Some of these managers awakened to the necessity of meeting these deficiencies before the general revival of prosperous conditions last year, but others did not awaken to the needs of their roads until the present year, and it is to the suddenness of this awakening that much of the existing unprecedented demand for iron and steel is due.

The decline in the production of iron and steel, which began in the second half of 1903, was not generally arrested in the first half of 1904 and was particularly noticeable in June and July, but it was entirely checked in August and September. The production during the year was less in many lines than in 1903, the increased activity in the last few months of the year falling very far short of equaling the losses in production during the remainder of the year. The production in all lines in 1905 promises to be much the largest in the history of the country. The production of pig iron in the first half of 1905 was 11,163,175 long tons, against 8,323,595 tons in the last half of 1904 and 8,173,438 tons in the first half of 1904. The increase in production in the first half of 1905 as compared with the second half of 1904 amounted to 2,839,580 tons, and as compared with the first half to 2,989,737 tons.

Naturally and properly prices of iron and steel have advanced since the improvement in demand began in August and September of last year, but this advance has wisely been kept within reasonable bounds. Steel rails have not been advanced at all. Such advances as have taken place have been justified in large part by advances in the prices of raw materials. Prices in 1904 were at their lowest ebb in the third quarter; some prices were the lowest that had been reached since the reaction in 1903 began. The average monthly price of Bessemer pig iron at Pittsburg fell in September, 1904, to $12.69 per ton, from which there was a gradual advance to an average of $16.72 in December and January. At the end of April the price was $16.35.

The workingmen employed at iron and steel works and in auxiliary mining operations and at coke works have shared in the general revival of prosperity. They have had steady employment and their wages have been increased from 10 to 20 per cent.

GENERAL STATISTICAL SUMMARY.

The following table gives the shipments in 1903 and 1904 of Lake Superior iron ore, the shipments of coke and of anthracite coal, the total production of iron ore, coal, and coke, and of all iron and steel, the imports and exports of iron and steel, etc.

Summary of iron, steel, etc., statistics for the United States for 1903 and 1904.

[Long tons, except for coke and nails.]

Item.	1903.	1904.
Shipments of iron ore from Lake Superior	24,289,878	21,822,839
Total production of iron ore	35,019,308	27,644,330
Shipments of Pennsylvania anthracite coal	59,362,831	57,492,522
Total production of all kinds of coal	319,068,229	314,421,255
Total production of coke .... short tons	25,262,360	23,621,520
Shipments of Connellsville coke .... do	13,345,230	12,427,468
Shipments of Pocahontas Flat Top coke .... do	1,693,403	1,617,801
Production of pig iron, including spiegeleisen and ferromanganese	18,009,252	16,497,033
Production of spiegeleisen, ferromanganese, and ferrophosphorous	192,661	220,392
Production of Bessemer steel ingots and castings	8,592,829	7,859,140
Production of open-hearth steel ingots and castings	5,829,911	5,908,166
Production of all kinds of steel ingots and castings	14,534,978	13,859,887
Production of structural shapes, not including plates	1,095,813	949,146
Production of plates and sheets, except nail plate	2,599,665	2,421,398
Production of all rolled iron and steel, except rails	10,215,220	9,728,670
Production of Bessemer steel rails	2,946,756	2,137,957
Production of all kinds of rails	2,992,477	2,284,711
Production of iron and steel wire rods	1,503,455	1,699,028
Production of all rolled iron and steel, including rails	13,207,697	12,013,381
Production of iron and steel cut nails .... kegs of 100 pounds	1,435,893	1,283,362
Production of iron and steel wire nails .... do	9,631,661	11,926,661
Imports of iron ore	980,440	487,613
Exports of iron ore	80,611	213,865
Imports of iron and steel, foreign value	$41,255,864	$21,621,970
Exports of iron and steel, home value	$99,035,865	$128,553,613
Miles of new railroad built (estimated for 1904)	4,715	4,252
Tonnage of steel vessels built in the calendar year	295,840	160,809

An examination of the foregoing table will show how general was the reaction in the iron trade and auxiliary industries in 1904. There was a shrinkage in that year in nearly all lines of production as compared with 1903. The decrease in the production of pig iron was 1,512,219 long tons; in Bessemer steel ingots and castings, 733,689 long tons; and in all kinds of rails, 707,716 long tons. The decrease in the shipments of Pennsylvania anthracite coal was 1,870,309 long tons; in Lake Superior iron ore, 2,467,039 long tons, and in Connellsville coke, 917,762 short tons. The only noteworthy increases in production in 1904 as compared with 1903 were in open-hearth steel, 78,255 long tons; in wire rods, 195,573 long tons; and in wire nails, 2,295,000 kegs. The decline in imports of iron and steel in 1904 as compared with 1903, and the increase in exports were features of the iron trade in 1904 which helped to mitigate the severity of the reaction in that year.

SHIPMENTS OF ANTHRACITE COAL AND CUMBERLAND COAL.

The shipments of anthracite coal from the Pennsylvania mines in 1904 amounted to 57,492,522 long tons, against 59,362,831 tons in 1903, a decrease of 1,870,309 tons, against 31,200,890 tons in 1902 (the year of the great anthracite coal strike), 53,568,601 tons in 1901, and 45,107,484 tons in 1900. These figures are furnished by Mr. W. W. Ruley, of Philadelphia, the anthracite coal statistician.

The shipments of Cumberland coal from the mines of western Maryland and West Virginia in 1904 amounted to 5,905,388 long tons, against 6,032,176 tons in 1903, 6,288,867 tons in 1902, 6,139,329 tons in 1901, 5,171,916 tons in 1900, 6,131,461 tons in 1899, 5,533,636 tons in 1898, and 5,303,489 tons in 1897.

SHIPMENTS OF CONNELLSVILLE AND POCAHONTAS COKE.

Mr. H. P. Snyder, the editor of the Connellsville Courier, reports that the shipments of coke from the Connellsville region in 1904 amounted to 12,427,468 short tons, against 13,345,230 tons in 1903 and 14,138,740 tons in 1902.

The average price of all coke shipped from the Connellsville region in 1904 was $1.75 per short ton, against $3 in 1903 and $2.37 in 1902. The gross revenue received from the sale of Connellsville coke in 1904 was $21,748,069, against $40,035,690 in 1903 and $33,508,714 in 1902. In the first quarter of 1904 the average price of all coke was $1.80 per ton. Toward the latter part of March the price dropped as low as $1.50 a ton for standard Connellsville furnace coke. The average of all coke for the second quarter was $1.60 and for the third quarter $1.65 per ton. Late in September there was a general stiffening of prices. They improved steadily, and as a result the last quarter of the year ended with an average price for all coke of $2.25. There was little advance, however, until December. Then, with furnaces blowing in, the demand for coke became acute. Prices soon ran over $3 for furnace coke and to $3.25 and $3.35 for foundry coke.

Mr. Snyder states that the prices of Connellsville furnace coke for the first five months of 1905 were as follows, per short ton: January, $2.50; February, $2.45; March, $2.35; April, $2; and May, $2. The prices of foundry coke were about 35 cents per ton higher than the above prices.

The shipments of Pocahontas Flat Top coke in 1904, furnished by the Norfolk and Western Railway Company, amounted to 1,617,801 short tons, against 1,693,403 tons in 1903, 1,191,436 tons in 1902, 1,279,949 tons in 1901, 1,341,444 tons in 1900, 1,317,246 tons in 1899, and 1,276,172 tons in 1898.

LAKE SUPERIOR IRON-ORE SHIPMENTS.

The Iron Trade Review gives full details of the shipments of iron ore from the Lake Superior region in 1904 and in preceding years. The total shipments by water and by all-rail routes in 1904 amounted to 21,822,839 long tons, against 24,289,878 tons in 1903, a decrease of 2,467,039 tons, or over 10 per cent.

The Review says that the list of shipping mines in the Lake Superior ranges contained 135 names in 1904, against 142 in 1903, as follows: Marquette, 20; Menominee, 30; Gogebic, 22; Vermilion, 6; Mesabi, 55; Iron Ridge, Wisconsin, 1; Illinois mine, Baraboo district, 1. More than 135 mines shipped ore in 1904. In a few cases two or more mines are included under one name.

The following table gives the shipments in long tons of Lake Superior iron ore in the last four years by ranges and by ports and all rail. The figures include all shipments to local furnaces.

Shipments of Lake Superior iron ore, 1901–1904, by ranges and by ports.

[Long tons.]

	1901.	1902.	1903.	1904.
RANGE.				
Marquette	3,245,346	3,868,025	3,040,245	2,843,703
Menominee	3,619,083	4,612,509	3,749,567	3,074,848
Gogebic	2,938,155	3,663,484	2,912,912	2,398,287
Vermilion	1,786,063	2,084,263	1,676,699	1,282,513
Mesabi	9,004,890	13,342,840	12,892,542	12,156,008
Miscellaneous	....	....	17,913	67,480
Total	20,593,537	27,571,121	24,289,878	21,822,839
PORT.				
Escanaba	4,022,668	5,413,704	4,277,561	3,644,267
Marquette	2,354,284	2,595,010	2,007,346	1,907,301
Ashland	2,886,252	3,553,919	2,823,119	2,288,400
Two Harbors	5,018,197	5,605,185	5,120,656	4,566,542
Gladstone	117,089	92,375	85,816	553
Superior	2,321,077	4,180,568	3,978,579	4,169,990
Duluth	3,437,955	5,598,408	5,356,473	4,649,611
All rail	436,015	531,952	640,328	596,175
Total	20,593,537	27,571,121	24,289,878	21,822,839

Under "miscellaneous" in 1903 the shipments from the Iron Ridge mine only are included, but in 1904 the shipments from the Baraboo district as well as from the Iron Ridge mine are included.

The Marquette range is wholly in Michigan, the Menominee and Gogebic ranges are partly in Michigan and partly in Wisconsin, and the Vermilion and Mesabi ranges are in Minnesota. The Iron Ridge mine is located in Dodge County, Wis., and the newly developed Baraboo district is in the adjoining counties of Sauk and Columbia—all in southern Wisconsin. Prior to 1903 the shipments from the Iron Ridge mine, which amounted to 17,913 tons in 1903 and to 19,558 tons in 1904, were not included in Lake Superior statistics. The production of the Baraboo district in 1903 was a little less than 19,000 tons, but no ore was shipped. Shipments from this district began in 1904, in which year they amounted to 47,922 tons.

The decline in iron-ore shipments in 1904 as compared with 1903 was chiefly in the Mesabi, the Menominee, and the Gogebic ranges, the decrease in the three ranges being as follows: Mesabi, 736,534 tons, Menominee, 674,719 tons, and Gogebic, 514,625 tons; total, 1,925,878 tons. In the Vermilion and Marquette ranges the falling off amounted to 590,728 tons, of which 394,186 tons were in the Vermilion range and 196,542 tons were in the Marquette range.

The shipments from the Lake Superior mines of the United States Steel Corporation in 1904 amounted to 11,746,409 long tons, or 53.8 per cent of the total, as compared with similar shipments of 14,293,083 tons, or 58.8 per cent, in 1903. In each year the figures include the ore shipped from the Iron Ridge mine of the Illinois Steel Company, in Wisconsin, although, strictly speaking, this mine is not in the Lake Superior region.

The total shipments in 1904 from the Helen mine on the Canadian side amounted to 116,968 tons and are not included in the above tables. Of these shipments 76,421 tons were sent to Lake Erie ports in the United States and 40,547 tons to Canada. In 1903 the Helen mine shipments amounted to 203,419 tons, of which 170,672 tons were sent to the United States.

LARGEST SHIPPERS OF LAKE SUPERIOR IRON ORE.

The Lake Superior mines which shipped the largest quantities of iron ore in 1904 were the following: Norrie, in the Gogebic range, 618,638 tons; Ashland, in the Gogebic range, 344,102 tons; Aurora, in the Gogebic range, 212,920 tons; Tilden, in the Gogebic range, 204,581 tons; Pioneer, in the Vermilion range, 505,432 tons; Chandler, in the Vermilion range, 422,162 tons; Chapin, in the Menominee range, 541,324 tons; Aragon, in the Menominee range, 374,944 tons; Pewabic, in the Menominee range, 372,791 tons; Cleveland-Cliffs, in the Marquette range, 743,263 tons; Lake Superior, in the Marquette range, 590,339 tons; Queen, in the Marquette range, 311,479 tons; Lake Angeline, in the Marquette range, 262,486 tons; Stevenson, in the Mesabi range, 1,652,021 tons; Lake Superior group, in the Mesabi range, 1,415,884 tons; Mountain Iron, in the Mesabi range, 1,168,855 tons; Fayal, in the Mesabi range, 975,102 tons; Adams, in the Mesabi range, 940,105 tons; Mahoning, in the Mesabi range, 706,325 tons; Biwabik, in the Mesabi range, 647,614 tons; and Spruce, in the Mesabi range, 589,319 tons.

RECEIPTS OF IRON ORE AT LAKE ERIE PORTS.

The Iron Trade Review annually publishes full statistics of the receipts of Lake Superior iron ore at Cleveland, Ashtabula, Conneaut, Buffalo, and other ports on Lake Erie, the principal receipts being at Conneaut, Ashtabula, and Cleveland; also of the quantity left on the docks at the close of navigation. From these statistics the following summary from 1890 to 1904 is compiled:

Receipts of iron ore at Lake Erie ports, 1890–1904, by years.

[Long tons.]

Year.	Receipts.	On dock.
1890	6,874,664	3,893,487
1891	4,939,684	3,508,489
1892	6,660,734	4,149,451
1893	5,333,061	4,070,710
1894	6,350,825	4,834,247
1895	8,112,228	4,415,712
1896	8,026,432	4,954,984
1897	10,120,906	5,923,755
1898	11,028,321	5,126,407
1899	15,222,187	5,530,283
1900	15,797,787	5,904,670
1901	17,014,076	5,859,663
1902	22,649,424	7,074,254
1903	19,681,731	6,371,085
1904	17,932,814	5,763,399

The receipts of Lake Superior iron ore at Lake Erie ports in the last six years are given by the Review as follows, in long tons. The figures for Buffalo include the receipts at Tonawanda.

Receipts of Lake Superior iron ore at Lake Erie ports, 1899–1904, by ports.

Port.	1899.	1900.	1901.	1902.	1903.	1904.
Toledo	792,348	645,147	798,298	1,037,571	652,305	508,793
Sandusky	87,499	154,542	33,017	165,556	130,532	48,356
Huron	263,600	321,914	431,311	520,646	486,106	231,364
Lorain	1,112,946	1,090,235	721,662	1,442,417	990,490	972,931
Cleveland	3,222,582	3,376,644	3,831,060	4,873,318	4,434,160	3,572,228
Fairport	1,241,013	1,085,554	1,181,776	1,538,744	1,434,342	1,157,858
Ashtabula	3,341,526	3,709,486	3,981,170	4,796,805	4,242,160	3,639,250
Conneaut	2,320,696	2,556,631	3,181,019	4,300,301	3,903,937	4,083,655
Erie	1,309,961	1,240,715	1,379,377	1,717,268	1,257,798	1,284,778
Buffalo[a]	1,530,016	1,616,919	1,475,386	2,256,798	2,149,901	2,433,601
Total	15,222,187	15,797,787	17,014,076	22,649,424	19,681,731	17,932,814

[a] Includes receipts at Tonawanda.

SHIPMENTS OF IRON ORE FROM LEADING DISTRICTS.

The shipments of iron ore from some of the leading iron-ore districts of the country in the last three years were as follows:

Shipments of iron ore from leading districts, 1902–1904.

[Long tons.]

District.	1902.	1903.	1904.
Lake Superior mines of Michigan and Wisconsin	12,144,018	[a] 9,720,637	[a] 8,384,318
Vermilion and Mesabi mines of Minnesota	15,427,103	14,569,241	13,438,521
Missouri mines	65,645	57,477	38,420
Cornwall mines, Pennsylvania	594,177	401,469	174,331
New Jersey mines	399,984	472,490	502,506
Chateaugay mines, on Lake Champlain, N. Y	83,688	65,707	287,315
Port Henry mines, N. Y	365,437	373,565	299,817
Salisbury region, Connecticut	23,276	24,255	15,092
Cranberry mines, North Carolina	30,810	60,108	61,996
Tennessee Coal, Iron and Railroad Company's Inman mines in Tennessee	4,948	24,347	None.
The same company's mines in Alabama	1,276,969	1,302,207	1,162,389
Total of the above districts	30,416,055	27,071,503	24,364,685

[a] Includes 17,913 tons shipped from the Iron Ridge mine in 1903, and 19,558 tons shipped from the Iron Ridge mine and 47,922 tons from the Baraboo district in 1904.

IMPORTS OF IRON ORE IN 1902, 1903, AND 1904.

The following table, furnished by the Bureau of Statistics of the Department of Commerce and Labor, gives the quantities and values of iron ore imported into the United States in the calendar years 1902, 1903, and 1904:

Imports of iron ore into the United States, 1902–1904, by customs districts.

Customs district.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Baltimore	600,711	$1,401,326	490,920	$1,232,546	321,920	$738,010
New York	14,546	39,800	6,940	19,759	15,263	38,765
Philadelphia	338,848	597,895	303,722	560,880	82,186	143,892
Puget Sound	5,661	9,312	525	789		
Vermont	18	72	760	1,190	1,183	2,457
All other	205,686	534,672	177,573	445,844	67,061	178,260
Total	1,165,470	2,583,077	980,440	2,261,008	487,613	1,101,384

The imports of iron ore in 1904 included 77,887 long tons from Canada, valued at $177,966, received chiefly at Lake Erie ports. There were also imported in 1904 from Newfoundland into the customs district of Philadelphia 5,400 tons, valued at $5,400.

The following table, which gives the countries from which iron ore was imported into the United States during the calendar years 1902, 1903, and 1904, is also furnished by the Bureau of Statistics of the Department of Commerce and Labor:

Imports of iron ore into the United States, 1902–1904, by countries.

Country.	1902.		1903.		1904.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*		*Long tons.*	
Cuba	696,375	$1,576,617	613,585	$1,501,480	364,630	$822,413
Spain	153,527	338,261	94,720	196,139	36,810	89,218
French Africa	19,167	35,707	7,830	14,586	....	....
Greece	....	....	....	....	2,500	2,535
Newfoundland	81,920	81,918	86,730	86,680	5,400	5,400
United Kingdom	1,269	17,882	6,843	31,858	178	2,093
British Columbia	5,661	9,312	525	789	....	....
Germany	361	3,478	207	1,820	2	70
Quebec, Ontario, etc	203,824	509,711	169,681	424,440	77,882	177,966
Belgium	500	4,850	300	2,964	210	1,671
France	2,866	5,341	....	....	....	8
Other countries	....	....	19	242	1	10
Total	1,165,470	2,583,077	980,440	2,261,008	487,613	1,101,384

SHIPMENTS OF IRON ORE FROM CUBA.

In the calendar year 1904 two companies shipped iron ore from Cuba, namely, the Juragua Iron Company and the Spanish-American Iron Company, the shipments by the Juragua Company amounting to 31,162 tons, and the shipments by the Spanish-American Company amounting to 356,111 tons; total, 387,273 tons. Of the total shipments by the Spanish-American Company 350,574 tons were sent to the United States (of which 3,100 tons were lost at sea), 2,854 tons to England, and 2,683 tons to Santiago, Cuba, where it was used as a flux in a copper smelter. All the shipments of the Juragua Company were made to the United States. In 1903 these two companies were the only shippers of iron ore from Cuba, the total shipments of the Juragua Iron Company, Limited, and its successor, the Juragua Iron Company, amounting to 157,230 tons, and the shipments by the Spanish-American Company to 467,628 tons, a total of 624,858 tons. Of the total shipments in 1903 by the latter company 456,826 tons were sent to the United States and 10,802 tons to England.

The total shipments of iron ore by companies from Cuba to all countries from the opening of the mines in 1884 to the close of 1904 were as follows, in long tons: The Juragua Iron Company, Limited; and the Juragua Iron Company, 4,100,187 long tons; the Sigua Iron Company, 20,438 tons; the Spanish-American Iron Company, 2,600,857 tons; and the Cuban Steel Ore Company, 41,241 tons; total since 1884, 6,762,723 long tons.

With the exception of 5,932 long tons of iron ore shipped by the Juragua Iron Company, Limited, in 1897, to Pictou, Nova Scotia, and 51,537 tons shipped to foreign countries by the Spanish-American Iron Company in 1897, 4,200 tons shipped in 1899, 12,849 tons in 1901, 10,802 tons in 1903, and 5,537 tons in 1904, all the iron ore referred to above was shipped to the United States. The total shipments to foreign countries, including the 2,683 long tons shipped to Santiago in 1904, amounted to 90,857 long tons, and the total shipments to the United States to 6,671,866 long tons.

CONSUMPTION OF IRON ORE IN BLAST FURNACES.

We estimate our total consumption of domestic and foreign iron ore in the manufacture of pig iron in 1904 at 28,870,000 long tons, against 31,516,000 tons in 1903, 31,187,000 tons in 1902, 27,787,000 tons in 1901, and 24,131,000 tons in 1900.

To these estimates may be added the iron ore annually consumed in open-hearth steel furnaces and in rolling mills, etc., which amounted in the census year 1900 to 340,028 long tons.

EXPORTS OF IRON AND STEEL.

According to the Bureau of Statistics of the Department of Commerce and Labor the statistics of domestic exports of iron and steel in the calendar years 1903 and 1904, were as follows:

Exports of domestic iron and steel in 1903 and 1904.

Article.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Pig iron	20,379	$384,334	49,025	$764,543
Scrap and old	8,034	117,972	26,785	373,329
Bar iron	19,380	796,631	29,582	1,133,128
Steel bars or rods, other than wire rods	17,802	929,915	25,894	1,240,728
Steel wire rods	22,360	713,718	20,073	695,448
Iron rails	181	8,808	1,405	23,870
Steel rails	30,656	937,779	414,845	10,661,222
Billets, ingots, and blooms	5,445	141,924	314,324	6,150,035
Hoop, band, and scroll	2,141	101,839	3,435	162,039
Iron sheets and plates	4,782	273,618	4,728	248,120
Steel sheets and plates	13,312	657,713	50,477	2,064,241
Tin plates and terne plates	292	28,481	7,898	651,774
Structural iron and steel	30,641	1,788,556	55,514	2,777,768
Wire	108,521	5,528,726	118,581	5,935,093
Cut nails and spikes	8,890	424,985	9,274	416,455
Wire nails and spikes	31,453	1,410,105	32,788	1,599,005

Exports of domestic iron and steel in 1903 and 1904—Continued.

Article.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
All other, including tacks	2,321	$288,395	3,046	$350,837
Car wheels ... number	18,966	136,569	24,763	175,947
Castings, not elsewhere specified		1,765,901		1,872,314
Cutlery		389,837		435,092
Firearms		1,206,951		1,486,151
Cash registers ... number	20,260	1,825,503	20,070	1,871,100
Locks, hinges, etc		6,986,357		5,553,473
Saws		495,729		570,056
Tools, not elsewhere specified		4,658,972		5,053,084
Electrical machinery		5,104,502		6,675,766
Laundry machinery		552,291		512,542
Metal-working machinery		3,316,088		3,483,232
Printing presses, and parts of		1,143,122		1,450,993
Pumps and pumping machinery		2,729,288		2,733,625
Sewing machines		5,340,474		6,019,161
Shoemaking machinery		834,995		1,240,096
Fire engines ... number	8	16,657	3	6,062
Locomotive engines ... do	287	3,099,521	517	4,697,340
Stationary engines ... do	1,730	714,508	2,155	1,099,690
Parts of engines and boilers		2,273,834		2,003,323
Typewriting machines, and parts of		4,537,396		4,138,651
Wood-working machinery [a]		359,338		628,714
All other machinery		20,068,810		22,918,952
Pipes and fittings		5,919,340		7,303,900
Safes ... number	3,740	209,544	4,552	242,815
Scales and balances		762,305		608,513
Stoves, ranges, and parts of		981,475		810,971
All other manufactures		9,073,059		10,215,415
Total	326,590	99,035,865	1,167,674	128,553,613
Agricultural implements, additional		22,951,805		21,654,892
Iron ore	80,611	255,728	213,865	458,823

[a] Included in "All other machinery, etc.," prior to July 1, 1903.

EXPORTS OF AGRICULTURAL IMPLEMENTS.

The exports of agricultural implements from the United States amounted in the calendar year 1904 to $21,654,892, against $22,951,805 in 1903, $17,981,597 in 1902, $16,714,308 in 1901, $15,979,909 in 1900, $13,594,524 in 1899, $9,073,384 in 1898, and $5,302,807 in 1897.

IMPORTS OF IRON AND STEEL.

The following table, compiled from statistics obtained from the Bureau of Statistics of the Department of Commerce and Labor, gives the quantities and values of imports of iron and steel and manufactures thereof in the calendar years 1903 and 1904:

Imports of iron and steel into the United States in 1903 and 1904.

Article.	1903.		1904.	
	Quantity.	Value.	Quantity.	Value.
	Long tons.		*Long tons.*	
Pig iron, spiegeleisen, ferromanganese, etc	599,574	$11,173,302	79,500	$1,765,107
Scrap iron and scrap steel	82,921	1,273,941	13,461	189,506
Bar iron	43,393	1,904,469	20,911	918,842
Iron and steel rails	95,555	2,159,273	37,776	808,775
Hoop, band, and scroll iron or steel	1,525	74,898	2,135	60,934
Steel ingots, billets, blooms, etc	261,570	7,331,299	10,801	1,535,943
Sheet, plate, and taggers' iron or steel	11,557	540,272	4,165	302,500
Building forms, and all other structural shapes, fitted for use	8,865	256,265	7,203	210,936
Tin plates and terne plates	47,360	2,999,252	70,652	4,354,761
Wire rods, of iron or steel	20,836	1,028,977	15,313	707,779
Wire, and articles made from	5,018	728,430	3,956	624,892
Anvils	250	35,378	167	24,192
Chains	373	62,481	358	50,583
Cutlery	....	1,903,895	....	1,811,511
Files, file blanks, rasps, and floats	....	82,939	....	80,994
Firearms	....	687,917	....	586,571
Shotgun barrels, in single tubes	....	198,126	....	186,945
Machinery	....	3,927,165	....	2,792,885
Needles	....	466,294	....	428,975
All other	....	4,421,291	....	4,179,339
Total	1,178,797	41,255,864	266,398	21,621,970

The large imports of iron and steel in 1903 were caused by the abnormally large demand in 1902 and in the early part of 1903, many orders sent abroad in 1902 not being filled until 1903; but the great decline in the imports of iron and steel in 1904 was due to the reaction in the home demand in the second half of 1903, which continued into the summer of 1904.

Of the pig iron imported in recent years a large part was spiegeleisen and ferromanganese, but in 1902 and 1903 there was a great increase in the imports of foundry and Bessemer pig iron. This increase was not continued in 1904, but there will again be an increase in 1905.

In February, 1905, a cargo of 4,000 tons of English pig iron was received at Philadelphia to be exported back to England, with benefit of tariff drawback, as cast-iron pipe. Other purchases of foreign pig iron have since been made to be used in the export trade in steel rails and other finished products.

IMPORTS AND EXPORTS OF COAL AND COKE.

The domestic exports of anthracite coal in 1904 amounted to 2,228,392 long tons, against 2,008,857 tons in 1903. Domestic exports of bituminous coal in 1904 amounted to 6,345,126 long tons, against 6,303,241 tons in 1903. The total domestic exports in 1904 amounted to 8,573,518 long tons, against 8,312,098 tons in 1903. The imports of anthracite coal in 1904 for consumption amounted to 72,529 long tons, against 175,747 tons in 1903. The imports of bituminous coal, including shale and slack, in 1904 for consumption amounted to 1,550,751 long tons, against 3,303,683 tons in 1903. The total imports of coal in 1904 for consumption amounted to 1,623,280 long tons, against 3,479,430 tons in 1903. The domestic exports of coke in 1904 amounted to 585,872 short tons, against 466,351 tons in 1903. The imports of coke for consumption in 1904 amounted to 180,853 short tons, against 142,776 tons in 1903. All the preceding coal and coke figures were obtained from the Bureau of Statistics of the Department of Commerce and Labor.

PRICES OF LAKE SUPERIOR IRON ORE.

Below are given the prices at which Lake Superior iron ore was sold upon season contracts in 1903 and 1904, per long ton, delivered at lower ports on Lake Erie; also the prices at which sales were made in the spring of 1905 for season delivery. These prices have been furnished for this report by Mr. A. I. Findley, late editor of the Iron Trade Review.

Prices per long ton of Lake Superior iron ore in 1903–1905.

Grade.	1903.	1904.	1905.
Old range Bessemer	$4.50	$3.00 to $3.25	$3.75
Old range non-Bessemer	3.60	2.60 to 2.80	3.20
Mesabi Bessemer	4.00	2.75 to 3.00	3.50
Mesabi non-Bessemer	3.20	2.35 to 2.50	3.00

AVERAGE MONTHLY PRICES OF IRON AND STEEL.

In the following table are given the average monthly prices of leading articles of iron and steel in Pennsylvania in 1903 and 1904 and in the first four months of 1905. The prices named are per long ton, except for bar iron, which is quoted by the 100 pounds from store at Philadelphia and from mills at Pittsburg, and for steel bars by the 100 pounds at Pittsburg mills.

Average monthly prices of iron and steel in Pennsylvania from January, 1903, to April, 1905, inclusive.

Year and month.	Old iron T rails, at Philadelphia.	No. 1 foundry pig iron, at Philadelphia.	Gray forge pig iron, at Philadelphia.	Gray forge pig iron, at Pittsburg.	Bessemer pig iron, at Pittsburg.	Steel rails, at mills, in Pennsylvania.	Steel billets, at mills, at Pittsburg.	Best refined bar iron, from store, Philadelphia.	Best refined bar iron, at mills, at Pittsburg.	Bar steel, at mills, at Pittsburg.
1903.										
January	$23.50	$24.00	$20.50	$20.50	$22.85	$28.00	$29.60	$2.20	$2.00	$1.64
February	23.75	23.75	20.00	20.50	21.91	28.00	30.00	2.20	2.00	1.60
March	24.50	23.50	19.50	20.87	21.85	28.00	30.62	2.20	2.00	1.60
April	24.90	22.70	19.10	20.45	21.28	28.00	30.20	2.20	2.00	1.60
May	24.60	21.37	18.62	19.87	20.01	28.00	30.25	2.16	2.00	1.60
June	23.50	20.62	18.00	18.87	19.72	28.00	28.87	2.08	1.77	1.60
July	22.00	19.00	17.50	17.90	18.93	28.00	27.40	2.01	1.70	1.60
August	19.37	18.00	15.81	16.04	18.35	28.00	27.00	1.93	1.70	1.60
September	18.75	17.60	14.94	15.25	17.22	28.00	27.00	1.81	1.70	1.60
October	17.50	16.70	14.05	14.20	16.00	28.00	27.00	1.81	1.70	1.60
November	16.37	16.00	13.75	13.00	15.19	28.00	24.00	1.71	1.34	1.37
December	15.40	15.85	13.75	12.80	14.40	28.00	23.00	1.71	1.30	1.30
1904.										
January	15.87	15.50	13.50	12.81	13.90	28.00	23.00	1.71	1.30	1.30
February	15.00	15.50	13.50	12.75	13.66	28.00	23.00	1.71	1.31	1.30
March	16.70	15.45	13.50	13.17	14.03	28.00	23.00	1.71	1.38	1.33
April	18.37	15.75	13.75	13.09	14.19	28.00	23.00	1.71	1.50	1.35
May	15.85	15.40	13.55	12.62	13.60	28.00	23.00	1.71	1.50	1.32
June	14.50	15.19	13.31	12.27	12.81	28.00	23.00	1.71	1.50	1.30
July	14.12	14.94	13.12	11.92	12.46	28.00	23.00	1.71	1.50	1.30
August	14.55	15.00	13.00	11.89	12.76	28.00	23.00	1.71	1.50	1.31
September	15.50	15.00	12.87	11.75	12.69	28.00	21.25	1.71	1.50	1.33
October	16.25	15.12	13.19	12.30	13.10	28.00	19.50	1.71	1.50	1.30
November	17.70	16.40	14.75	14.25	15.15	28.00	20.40	1.71	1.52	1.32
December	20.25	17.62	16.00	15.85	16.72	28.00	21.00	1.81	1.76	1.38
1905.										
January	22.00	17.75	16.06	16.11	16.72	28.00	22.50	1.91	1.80	1.45
February	23.00	17.75	15.62	15.99	16.20	28.00	23.37	1.91	1.80	1.45
March	24.20	18.00	16.00	16.00	16.35	28.00	23.70	1.91	1.90	1.50
April	24.50	18.25	16.00	15.77	16.35	28.00	23.75	1.91	1.82	1.50

AVERAGE YEARLY PRICES OF IRON AND STEEL.

The following table gives the average yearly prices of leading articles of iron and steel in Pennsylvania and of wire nails at Chicago from 1900 to 1904. These prices are obtained by averaging monthly quotations, which have in turn been averaged from weekly quotations. The prices given are per ton of 2,240 pounds, except for bar iron and bar steel and cut and wire nails, which are quoted by the 100 pounds and in 100-pound kegs, respectively:

Average yearly prices of iron and steel, 1900–1904.

Article.	1900.	1901.	1902.	1903.	1904.
Old iron T rails, at Philadelphia	$19.51	$19.32	$23.83	$21.17	$16.22
No. 1 foundry pig iron, at Philadelphia	19.98	15.87	22.19	19.92	15.57
Gray forge pig iron, at Philadelphia	16.49	14.08	19.20	17.13	13.67
Gray forge pig iron, at Pittsburg	16.90	14.20	19.49	17.52	12.89
Bessemer pig iron, at Pittsburg	19.49	15.93	20.67	18.98	13.76
Steel rails, at mills, in Pennsylvania	32.29	27.33	28.00	28.00	28.00
Steel billets, at mills, at Pittsburg	25.06	24.13	30.57	27.91	22.18
Best bar iron, from store, at Philadelphia	1.96	1.84	2.13	2.00	1.72
Best bar iron, at mills, at Pittsburg	2.15	1.80	1.94	1.77	1.48
Steel bars, at mills, at Pittsburg	1.63	1.47	1.67	1.56	1.32
Cut nails, from store, at Philadelphia	2.46	2.29	2.29	2.36	2.01
Wire nails, base price, at Chicago	2.76	2.41	2.15	2.13	1.96

AVERAGE MONTHLY PRICES OF STEEL BARS AT PITTSBURG.

The following table, compiled from weekly quotations in the American Manufacturer, gives the average monthly prices of steel bars, per 100 pounds, at mills in Pittsburg from 1898 to 1904:

Average monthly prices of steel bars at Pittsburg, Pa., per 100 pounds, 1898–1904.

Month.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	$1.00	$1.07	$2.25	$1.20	$1.58	$1.64	$1.30
February	1.00	1.09	2.25	1.27	1.50	1.60	1.30
March	.99	1.48	2.25	1.44	1.60	1.60	1.33
April	.95	1.75	2.12	1.50	1.67	1.60	1.35
May	.95	1.71	1.94	1.50	1.80	1.60	1.32
June	.95	2.05	1.79	1.60	1.80	1.60	1.30
July	.95	2.00	1.24	1.52	1.72	1.60	1.30
August	.96	2.21	1.05	1.50	1.75	1.60	1.31
September	.99	2.50	1.12	1.50	1.75	1.60	1.33
October	1.00	2.60	1.15	1.52	1.69	1.60	1.30
November	1.01	2.46	1.18	1.60	1.60	1.37	1.32
December	1.00	2.25	1.20	1.60	1.68	1.30	1.38
Average	.98	1.93	1.63	1.47	1.67	1.56	1.32

The lowest quoted price at which steel bars were sold at Pittsburg within the last seven years was 95 cents per 100 pounds; this price prevailed in April, May, June, and July, 1898.

AVERAGE MONTHLY PRICES OF CUT NAILS AT PHILADELPHIA.

The following table gives the average monthly base prices of cut nails, per keg of 100 pounds, from store at Philadelphia, since 1897, as reported by the Duncannon Iron Company:

Average monthly prices of cut nails at Philadelphia, from store, 1897–1904.

[Per keg of 100 pounds.]

Month.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	$1.60	$1.35	$1.40	$2.80	$2.25	$2.30	$2.33	$2.05
February	1.56	1.35	1.65	2.80	2.27	2.20	2.36	2.00
March	1.55	1.30	1.75	2.80	2.27	2.25	2.36	2.00
April	1.50	1.30	1.95	2.62	2.30	2.30	2.41	2.05
May	1.45	1.30	1.95	2.45	2.30	2.30	2.41	2.05
June	1.45	1.30	2.20	2.42	2.30	2.30	2.41	2.05
July	1.40	1.30	2.30	2.30	2.30	2.30	2.41	2.05
August	1.40	1.30	2.35	2.30	2.30	2.30	2.41	2.00
September	1.45	1.30	2.60	2.25	2.35	2.30	2.41	1.95
October	1.45	1.30	2.75	2.28	2.30	2.30	2.41	1.90
November	1.40	1.30	2.80	2.30	2.30	2.30	2.20	2.00
December	1.40	1.30	2.80	2.25	2.30	2.30	2.20	2.05
Average	1.47	1.31	2.21	2.46	2.29	2.29	2.36	2.01

AVERAGE MONTHLY PRICES OF WIRE NAILS AT CHICAGO.

The following table, compiled from quotations in the Iron Age, gives the average monthly base prices of standard sizes of wire nails, per keg of 100 pounds, in carload lots, free on board at Chicago, in the eight years from 1897 to 1904, inclusive:

Average monthly prices of standard sizes of wire nails at Chicago, 1897–1904.

[Per keg of 100 pounds.]

Month.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
January	$1.50	$1.55	$1.59	$3.53	$2.35	$2.16	$2.08	$2.04
February	1.45	1.57	1.73	3.53	2.45	2.20	2.12	2.05
March	1.50	1.55	2.09	3.53	2.45	2.20	2.20	2.09
April	1.45	1.47	2.25	3.28	2.45	2.20	2.15	2.10
May	1.42	1.45	2.35	2.53	2.45	2.20	2.15	2.10
June	1.42	1.43	2.60	2.48	2.45	2.20	2.15	2.07
July	1.35	1.36	2.70	2.43	2.45	2.20	2.15	2.05
August	1.37	1.36	2.80	2.43	2.45	2.20	2.15	1.90
September	1.50	1.45	3.10	2.35	2.45	2.15	2.15	1.75
October	1.52	1.47	3.20	2.35	2.42	2.05	2.15	1.75
November	1.50	1.40	3.28	2.35	2.35	2.00	2.15	1.77
December	1.50	1.37	3.53	2.35	2.25	2.00	2.00	1.88
Average	1.46	1.45	2.60	2.76	2.41	2.15	2.13	1.96

AVERAGE MONTHLY PRICES OF STEEL SHIP PLATES AT PITTSBURG.

The following table gives the average monthly prices, per long ton, of steel ship plates free on board at Pittsburg from October 1, 1900, to May 15, 1905:

Average monthly prices of steel ship plates at Pittsburg, Pa., from October 1, 1900, to May 15, 1905.

[Per long ton.]

Month.	Price.	Month.	Price.	Month.	Price.
1900.		1902.		1904.	
October	$24.64	May	$35.84	January	$35.84
November	28.00	June	35.84	February	35.84
December	30.24	July	35.84	March	35.84
1901.		August	35.84	April	35.84
January	31.36	September	35.84	May	35.84
February	31.36	October	35.84	June	35.84
March	33.15	November	35.84	July	35.84
April	35.84	December	35.84	August	35.84
May	35.84	1903.		September	32.48
June	35.84	January	35.84	October	31.36
July	35.84	February	35.84	November	31.36
August	35.84	March	35.84	December	32.37
September	35.84	April	35.84	1905.	
October	35.84	May	35.84	January	33.60
November	35.84	June	35.84	February	35.35
December	35.84	July	35.84	March	35.84
1902.		August	35.84	April	35.84
January	35.84	September	35.84	May 15	35.84
February	35.84	October	35.84		
March	35.84	November	35.84		
April	35.84	December	35.84		

The average annual price of steel ship plates at Pittsburg was $34.87 per long ton in 1901, $35.84 in 1902, $35.84 in 1903, and $34.52 in 1904.

AVERAGE QUARTERLY PRICES OF BEAMS AND CHANNELS AT PITTSBURG.

The average quarterly prices, per 100 pounds, of steel beams and channels at Pittsburg from 1894 to 1905 have been as follows:

Average quarterly prices of beams and channels at Pittsburg, 1894–1905.

[Price per 100 pounds.]

Year.	First quarter.	Second quarter.	Third quarter.	Fourth quarter.	Average.	Year.	First quarter.	Second quarter.	Third quarter.	Fourth quarter.	Average.
1894	$1.21	$1.20	$1.27	$1.25	$1.23	1900	$2.25	$2.21	$1.68	$1.50	$1.91
1895	1.21	1.25	1.56	1.58	1.40	1901	1.51	1.60	1.60	1.60	1.58
1896	1.44	1.49	1.55	1.50	1.49	1902	1.60	1.60	1.60	1.60	1.60
1897	1.55	1.33	.98	1.09	1.24	1903	1.60	1.60	1.60	1.60	1.60
1898	1.15	1.15	1.19	1.20	1.17	1904	1.60	1.60	1.55	1.41	1.54
1899	1.35	1.60	2.12	2.25	1.83	1905	1.55	....	....	....	....

During the period covered by this table the lowest average quarterly price for beams and channels was in the third quarter of 1897, when the ruling price was 98 cents per 100 pounds. The highest average quarterly price was in the last quarter of 1899 and the first quarter of 1900, when it was $2.25 per 100 pounds.

AVERAGE MONTHLY PRICES OF DOMESTIC TIN PLATES.

The following table gives the average wholesale monthly prices of American Bessemer tin plates, I. C., 14 by 20, per box of 100 pounds, at mills in Pennsylvania, from 1901 to 1904, inclusive:

Average wholesale monthly prices of tin plates at mills in Pennsylvania, 1901–1904.

Month.	Price.	Month.	Price.	Month.	Price.	Month.	Price.
1901.		1902.		1903.		1904.	
January	$4.00	January	$4.00	January	$3.60	January	$3.56
February	4.00	February	4.00	February	3.60	February	3.45
March	4.00	March	4.00	March	3.80	March	3.45
April	4.00	April	4.00	April	3.80	April	3.45
May	4.00	May	4.00	May	3.80	May	3.45
June	4.00	June	4.00	June	3.80	June	3.45
July	4.00	July	4.00	July	3.80	July	3.41
August	4.00	August	4.00	August	3.80	August	3.30
September	4.00	September	4.00	September	3.80	September	3.30
October	4.00	October	4.00	October	3.80	October	3.30
November	4.00	November	3.60	November	3.65	November	3.39
December	4.00	December	3.60	December	3.60	December	3.47
Average	4.00	Average	3.93	Average	3.74	Average	3.41

The average monthly price of tin plates at mills in Pennsylvania was $3.55 per box in January, 1905; $3.55 in February, $3.55 in March, $3.55 in April, and $3.55 in May.

AVERAGE YEARLY PRICES OF FOREIGN TIN PLATES.

The following table gives the average yearly prices of imported coke Bessemer tin plates, I. C., 14 by 20, per box of 108 pounds, at New York, freight and duty paid, from 1890 to 1898, inclusive:

Average yearly prices of imported tin plates at New York, 1890–1898.

Year.	Price.	Year.	Price.	Year.	Price.
1890	$4.80	1893	$5.37	1896	$3.80
1891	5.34	1894	4.89	1897	3.90
1892	5.30	1895	3.87	1898	4.00

In recent years tin plates have been imported chiefly by the oil and canning interests to obtain the benefit of the drawback.

AVERAGE YEARLY PRICES OF DOMESTIC TIN PLATES.

The following table gives the average yearly prices of domestic Bessemer tin plates, I. C., 14 by 20, per box of 100 pounds, at mills in Pennsylvania, from 1899 to 1904, inclusive:

Average yearly prices of domestic tin plates, 1899–1904.

Year.	Price.	Year.	Price.	Year.	Price.
1899	$4.06	1901	$4.00	1903	$3.74
1900	4.47	1902	3.93	1904	3.41

TOTAL PRODUCTION OF PIG IRON.

Twenty States made pig iron in 1904, against 22 in 1903. The total production of pig iron in 1904 was 16,497,033 long tons, against 18,009,252 tons in 1903. The following table gives the half-yearly production of pig iron in the last six years:

Production of pig iron in the United States, 1899–1904, by half years.

[Long tons.]

Period.	1899.	1900.	1901.	1902.	1903.	1904.
First half	6,289,167	7,642,569	7,674,613	8,808,574	9,707,367	8,173,438
Second half	7,331,536	6,146,673	8,203,741	9,012,733	8,301,885	8,323,595
Total	13,620,703	13,789,242	15,878,354	17,821,307	18,009,252	16,497,033

The production of pig iron in 1904 was 1,512,219 tons less than in 1903. The last months of 1904 showed a steady increase.

The following table gives the production of pig iron by States in 1903 and 1904, in the order of their prominence in 1903:

Production of pig iron in 1903 and 1904, by States.

[Long tons.]

State.	1903.	1904.	State.	1903.	1904.
Pennsylvania	8,211,600	7,644,321	Michigan	244,709	233,225
Ohio	3,287,434	2,977,929	New Jersey	211,667	262,294
Illinois	1,692,375	1,655,991	West Virginia	199,013	270,945
Alabama	1,561,398	1,453,513	Kentucky	102,441	37,106
New York	552,917	605,709	North Carolina	75,602	70,156
Virginia	544,034	310,526	Georgia		
Tennessee	418,368	302,096	Connecticut	14,501	8,922
Maryland	324,570	293,441	Texas	11,653	6,530
Wisconsin	283,516	210,404	Massachusetts	3,265	3,149
Minnesota			Total	18,009,252	16,497,033
Missouri	270,289	151,776			
Colorado					
Washington					

PRODUCTION OF PIG IRON ACCORDING TO FUEL.

The production of pig iron in 1904, classified according to the fuel used, was as follows, compared with the four preceding years:

Production of pig iron according to fuel used, 1900–1904.

[Long tons.]

Fuel used.	1900.	1901.	1902.	1903.	1904.
Bituminous, chiefly coke	11,727,712	13,782,386	16,315,891	15,592,221	14,931,364
Anthracite and coke mixed	1,636,366	1,668,808	1,096,040	1,864,199	1,196,867
Anthracite alone	40,682	43,719	19,207	47,148	31,273
Charcoal	339,874	360,147	378,504	504,757	337,529
Charcoal and coke	44,608	23,294	11,665	927	....
Total	13,789,242	15,878,354	17,821,307	18,009,252	16,497,033

PRODUCTION OF BESSEMER PIG IRON.

The production of Bessemer and low-phosphorus pig iron in 1904 amounted to 9,098,659 tons, against 9,989,908 tons in 1903. The following table gives the production of Bessemer pig iron by States in each year from 1899 to 1904. Bessemer pig iron made with charcoal is included. Low-phosphorus pig iron is included for 1901, 1902, 1903, and 1904, but not for 1899 and 1900.

Production of Bessemer pig iron in 1899–1904, by States.

[Long tons.]

State.	1899.	1900.	1901.	1902.	1903.	1904.
Pennsylvania	4,473,493	4,212,397	4,885,877	5,130,022	5,213,143	4,511,999
Ohio	1,852,965	1,898,663	2,637,091	2,927,605	2,422,676	2,138,442
Illinois	1,330,169	1,178,241	1,394,430	1,495,298	1,386,683	1,424,030
Maryland	210,670	260,688	297,149	296,971	321,784	292,642
West Virginia North Carolina	187,858	169,802	166,597	182,937	198,688	267,505
Colorado	96,364	118,146	147,216	201,580	176,116	112,318
Kentucky Tennessee	22,756	13,430	....	9,746	26,856	25,209
Wisconsin Michigan Minnesota	14,519	21,785	39,941	82,328	111,340	76,031
New Jersey New York	13,984	40,300	28,492	66,681	129,323	250,483
Virginia Alabama	....	....	....	....	3,299	....
Total	8,202,778	7,943,452	9,596,793	10,393,168	9,989,908	9,098,659

Of the production of Bessemer and low-phosphorus pig iron in Pennsylvania in 1904 the Lehigh Valley made 64,494 tons; the Schuylkill Valley, 38,973 tons; the lower Susquehanna Valley, 255,091 tons;

Allegheny County, 2,975,596 tons; the Shenango Valley, 752,238 tons; and the remainder of the State, 425,607 tons; total, 4,511,999 tons.

In Ohio in 1904 the Mahoning Valley produced 914,445 tons of Bessemer and low-phosphorus pig iron; the Hanging Rock bituminous district, 101,656 tons; the lake counties, 596,932 tons; and other parts of Ohio, 525,409 tons; total, 2,138,442 tons.

PRODUCTION OF BASIC PIG IRON.

The production of basic pig iron in 1904, not including charcoal pig iron of basic quality, was 2,483,104 tons, against 2,040,726 tons in 1903, an increase of 442,378 tons. The production of basic pig iron, by States, since 1900 is given in the following table:

Production of basic pig iron, 1900–1904, by States

[Long tons.]

State.	1900.	1901.	1902.	1903.	1904.
New York and New Jersey	4,929	34,320	90,736	117,802	113,688
Pennsylvania, Allegheny County	446,543	568,516	932,532	791,175	1,245,142
Pennsylvania, other counties	344,065	442,744	596,216	626,078	560,605
Virginia, Tennessee, and Alabama	179,717	301,444	295,191	267,999	319,329
Ohio, Illinois, Wisconsin, Missouri, and Colorado	97,122	101,826	123,915	237,672	244,340
Total	1,072,376	1,448,850	2,038,590	2,040,726	2,483,104

Maryland, Tennessee, Illinois, and Wisconsin did not make basic pig iron in 1901 or 1902, as in some previous years, and Maryland and Wisconsin did not make any in 1903 or 1904. Colorado made basic pig iron for the first time in 1903, but was not a producer in 1904.

A significant feature of these statistics is the increased production of basic pig iron in 1904, a year of generally reduced production. In the same year the production of Bessemer pig iron declined 891,249 tons as compared with the production in 1903.

PRODUCTION OF SPIEGELEISEN, FERROMANGANESE, AND FERROPHOSPHORUS.

The production of spiegeleisen, ferromanganese, and ferrophosphorus in 1904, included in the total production of pig iron, was 220,392 tons, against 192,661 tons in 1903. The production of ferromanganese alone in 1904 amounted to 57,076 tons, against 35,961 tons in 1903, and of spiegeleisen alone to 162,370 tons, against 156,700 tons in 1903. The spiegeleisen and ferromanganese produced in 1904 were made by New Jersey, Pennsylvania, Illinois, and Colorado. Tennessee was the only State which made ferrophosphorus in 1904, its production amounting to 946 tons, all made by one company. In 1903 no ferrophosphorus was reported by pig-iron manufacturers.

PRODUCTION OF PIG IRON IN PENNSYLVANIA, BY DISTRICTS.

The production of pig iron in Pennsylvania, by districts, in 1904 was as follows: Lehigh Valley, 456,028 tons; Schuylkill Valley, 409,416 tons; lower Susquehanna Valley, 397,156 tons; Juniata Valley, 120,471 tons; Allegheny County, 4,383,169 tons; Shenango Valley, 1,011,440 tons; western Pennsylvania, except Allegheny County and the Shenango Valley, 864,048 tons; charcoal (whole State), 2,593 tons; total, 7,644,321 tons. Pig iron was not made in the upper Susquehanna Valley in 1903 or 1904.

In 1904 the Shenango Valley lowered its output 126,721 tons as compared with 1903; Allegheny County increased its production 171,600 tons; western Pennsylvania, outside of Allegheny County and the Shenango Valley, decreased 62,966 tons; the Lehigh Valley lost 192,793 tons; the Schuylkill Valley lost 141,144 tons; the lower Susquehanna Valley lost 100,450 tons; the Juniata Valley lost 113,228 tons; and charcoal lost 1,477 tons.

In 1901, 1902, and 1903 Allegheny County made a little more than one-half the production of Pennsylvania but less than one-fourth the country's total production. In 1904 it made 57.3 per cent of the total production of Pennsylvania and over 26 per cent of the country's total production.

In each of the years 1902 and 1903 Pennsylvania made 45.5 per cent of the country's total production of pig iron, and in 1904 it made a little over 46.3 per cent.

PRODUCTION OF PIG IRON IN OHIO, BY DISTRICTS.

The production of pig iron in Ohio in 1904, by districts, was as follows: Mahoning Valley, including the furnaces at Leetonia, 1,217,186 tons; Hocking Valley, 17,600 tons; lake counties, 807,257 tons; miscellaneous bituminous, 687,601 tons; Hanging Rock bituminous, 247,297 tons; Hanging Rock charcoal, 988 tons; total, 2,977,929 tons.

The decrease in production in the Mahoning Valley, including the furnaces at Leetonia, in 1904 compared with 1903 was 46,773 tons; in the lake counties the decrease was 21,647 tons; in the miscellaneous bituminous district it was 142,851 tons; in the Hanging Rock bituminous district it was 80,382 tons; in the Hanging Rock charcoal district it was 8,552 tons; and in the Hocking Valley it was 9,300 tons.

Of the country's total production in 1904 Ohio made a little over 18 per cent, almost the same percentage as in 1903.

PRODUCTION IN THE SHENANGO AND MAHONING VALLEYS.

The production of pig iron in the Mahoning Valley, in Ohio, which includes the furnaces at Leetonia, and in the Shenango Valley, in

Pennsylvania, in 1898 was almost exactly the same, the former producing 769,334 tons and the latter 769,677 tons. In 1899 the Mahoning Valley made 932,165 tons and the Shenango Valley made 937,215 tons. In 1900 the Mahoning Valley went away ahead of its rival, making 1,002,362 tons, against 800,214 tons in the Shenango Valley. In 1901 the Mahoning Valley further increased its lead, producing 1,404,857 tons, against 979,875 tons in the Shenango Valley. In 1902 the Mahoning Valley increased its production to 1,438,087 tons, while the Shenango Valley jumped to 1,254,933 tons, the gain in the Mahoning Valley amounting only to 33,230 tons, while the Shenango Valley increased its production 275,058 tons, showing a comparative gain of 241,828 tons in favor of the Shenango Valley, although the Mahoning Valley was still 183,154 tons in the lead. In 1903 the Mahoning Valley produced 1,263,959 tons and the Shenango Valley produced 1,138,161 tons, a decrease as compared with 1902 of 174,128 tons in the Mahoning Valley and of 116,772 tons in the Shenango Valley. In this year the Mahoning Valley led its rival by 125,798 tons. In 1904 the production in the Mahoning Valley fell to 1,217,186 tons, a loss as compared with 1903 of 46,773 tons. In the Shenango Valley the production also declined in 1904, falling to 1,011,440 tons, a loss of 126,721 tons. In that year the gain in the Mahoning Valley over its Pennsylvania rival amounted to 205,746 tons.

STOCKS OF UNSOLD PIG IRON.

Statistics of stocks of unsold pig iron do not include pig iron made by the owners of rolling mills or steel works for their own use, but only pig iron made for sale and which had not been sold. The stocks of pig iron which were unsold in the hands of manufacturers, or which were under their control in warrant yards and elsewhere at the close of 1904, and were not intended for their own consumption, amounted to 408,792 tons, against 623,254 tons on June 30, 1904, and 591,438 tons on December 31, 1903. Warrant stocks not controlled by the makers are not included. The American Pig Iron Storage Warrant Company held 55,350 tons of pig iron in its yards on December 31, 1904, of which 17,700 tons, included above, were reported to us as being still controlled by the makers, leaving 37,650 tons in other hands. Adding this 37,650 tons to the 408,792 tons noted above gives us a total of 446,442 tons that were on the market at the close of 1904, against 598,489 tons in 1903, 49,951 tons in 1902, 73,647 tons in 1901, and 446,020 tons in 1900.

NUMBER OF COMPLETED FURNACES.

The whole number of completed furnaces in the United States at the close of 1904 was 429, against 425 at the close of 1903. The following table shows the number of furnaces at the end of each year since 1899, not counting abandoned furnaces:

Number of completed furnaces, 1899–1904, according to fuel used.

Fuel used.	1899.	1900.	1901.	1902.	1903.	1904.
Bituminous coal and coke	235	240	257	272	288	300
Anthracite and anthracite and coke mixed	99	94	90	81	77	73
Charcoal and charcoal and coke mixed	80	72	59	59	60	56
Total	414	406	406	412	425	429

During the first six months of 1904 the number of furnaces actually in blast during a part or the whole of the period was 295, and during the last half of the year the number was 297.

FURNACES IN BLAST IN THE LAST SIX YEARS.

The whole number of furnaces in blast on December 31, 1904, was 261, against 216 on June 30, 1904, and 182 on December 31, 1903. The number of furnaces in blast at the end of 1904 was 45 larger than on June 30 of the same year and 79 larger than on December 31, 1903. The number of furnaces out of blast at the close of 1904 was 168, as compared with 243 at the end of 1903. The following table shows the number of furnaces in blast at the close of each year since 1899:

Number of furnaces in blast, 1899–1904, according to fuel used.

Fuel used.	1899.	1900.	1901.	1902.	1903.	1904.
Bituminous coal and coke	191	155	188	222	120	206
Anthracite and anthracite and coke mixed	68	45	54	52	29	38
Charcoal and charcoal and coke mixed	30	32	24	33	33	17
Total	289	232	266	307	182	261

ANNUAL CONSUMPTION OF PIG IRON.

The consumption of pig iron in the last five years is approximately shown in the following table. Warrant stocks not controlled by the makers are included in unsold stocks for each year.

Annual consumption of pig iron in the United States, 1900–1904.

[Long tons.]

	1900.	1901.	1902.	1903.	1904.
Domestic production	13,789,242	15,878,354	17,821,307	18,009,252	16,497,033
Imported	52,565	62,930	619,354	599,574	79,500
Stocks unsold Jan. 1	68,309	446,020	73,647	49,951	598,489
Total supply	13,910,116	16,387,304	18,514,308	18,658,777	17,175,022
Deduct stocks Dec. 31	446,020	73,647	49,951	598,489	446,442
Also exports	286,687	81,211	27,487	20,379	49,025
Approximate consumption	13,177,409	16,232,446	18,436,870	18,039,909	16,679,555

Although the production of pig iron in 1904 fell below that of 1903 by 1,512,219 tons, the consumption in 1904 was only 1,360,354 tons less than in 1903, the stocks of unsold pig iron at the close of 1904 being 152,047 tons less than at the close of 1903, while imports of pig iron greatly declined in 1904.

LIMESTONE CONSUMED IN MAKING PIG IRON.

The limestone consumed for fluxing purposes by the blast furnaces of the United States in the production of 16,497,033 tons of pig iron in 1904 amounted to 8,195,036 long tons. The average consumption of limestone per ton of all kinds of pig iron produced was 1,112.6 pounds in 1904, against 1,193 pounds in 1903, 1,192.8 pounds in 1902, 1,186.5 pounds in 1901, and 1,205.6 pounds in 1900. The consumption in 1904 by the anthracite and bituminous furnaces was 1,128 pounds per ton of pig iron made, and by the charcoal furnaces it was 373.6 pounds.

PRODUCTION OF PIG IRON BY GRADES.

The following table gives the total production of pig iron in the United States in 1900, 1901, 1902, 1903, and 1904, by grades. Prior to 1900 the production of all grades was not ascertained. A few thousand tons of castings direct from the furnace are included in the totals for white and mottled and miscellaneous grades of pig iron for 1903 and 1904.

Production of pig iron in 1900-1904, by grades.

[Long tons.]

Grade.	1900.	1901.	1902.	1903.	1904.
Bessemer and low phosphorus	7,979,327	9,596,793	10,393,168	9,989,908	9,098,659
Basic (mineral fuel)	1,072,376	1,448,850	2,038,590	2,040,726	2,483,104
Forge pig iron	793,092	639,454	833,093	783,016	550,836
Foundry and high silicon	3,376,445	3,548,718	3,851,276	4,409,023	3,827,229
Malleable Bessemer	173,413	256,532	311,458	473,781	263,529
White and mottled and miscellaneous	129,909	87,964	172,085	120,137	63,284
Spiegeleisen	207,505	231,822	168,408	156,700	162,370
Ferromanganese	48,472	59,639	44,573	35,961	58,022
Direct castings	8,703	8,582	8,656	....	....
Total	13,789,242	15,878,354	17,821,307	18,009,252	16,497,033

Of the total production of pig iron in 1904 over 55.1 per cent was Bessemer and low phosphorus, as compared with over 55.4 per cent in 1903; nearly 23.2 per cent was foundry, against 24.4 per cent in 1903; 15 per cent was basic, against over 11.3 per cent in 1903; 3.3 per cent was forge; 1.3 per cent was spiegeleisen and ferromanganese; and almost 1.6 per cent was malleable Bessemer. White and mottled and miscellaneous grades and furnace castings did not amount to 1 per cent in 1903 and 1904.

Included in the 3,827,229 tons of foundry pig iron made in 1904 are 69,730 tons of ferrosilicon, made in Pennsylvania, Virginia, West Virginia, Kentucky, and Ohio, a small part of which was made with electricity. In 1903, 51,516 tons of ferrosilicon were made. Pig iron containing 7 per cent of silicon and over is classified as ferrosilicon. Virtually all the charcoal iron made is classified as foundry pig iron. Alabama is now the leading producer of foundry pig iron and Pennsylvania of forge pig iron.

PRODUCTION OF BESSEMER STEEL.

The total production of Bessemer steel ingots and castings in the United States in 1904 was 7,859,140 long tons, against 8,592,829 tons in 1903, a decrease of 733,689 tons, or 8.5 per cent. The production in 1903 was 545,534 tons less than in 1902, in which year the production was the largest in the history of the country.

The following table gives the production of Bessemer steel ingots and castings in the last five years by States. Of the production in 1904, 16,051 tons were direct castings, against a similar production of 18,099 tons in 1903 and 12,548 tons in 1902.

Production of Bessemer steel in the United States, 1900–1904, by States.

[Long tons.]

State.	1900.	1901.	1902.	1903.	1904.
Pennsylvania	3,488,731	4,293,439	4,209,326	3,909,436	3,464,650
Ohio	1,388,124	2,154,846	2,528,802	2,330,134	2,050,115
Illinois	1,115,571	1,324,217	1,443,614	1,306,569	1,257,190
Other States	692,344	940,800	956,621	986,690	1,087,185
Total	6,684,770	8,713,302	9,138,363	8,592,829	7,859,140

There were no Clapp-Griffiths works in operation in 1904 and only 2 Robert-Bessemer plants were active. Eleven Tropenas plants were at work, as compared with 8 in 1903. In addition 2 plants made steel by the Bookwalter process and 5 plants in special converters. With the exception of the Clapp-Griffiths plant all these works make a specialty of steel castings.

The following table gives separately the production of Bessemer steel ingots and castings from 1898 to 1904, all made by the acid process. Prior to 1898 Bessemer castings were included with ingots. Basic Bessemer steel has not been made in this country since 1897, when about 69,000 tons of ingots were produced at Troy, New York, by the Troy Steel Company.

Production of Bessemer ingots and castings, 1898–1904.

[Long tons.]

Year.	Ingots.	Castings.	Total.
1898	6,605,478	3,539	6,609,017
1899	7,582,415	3,939	7,586,354
1900	6,678,303	6,467	6,684,770
1901	8,706,538	6,764	8,713,302
1902	9,125,815	12,548	9,138,363
1903	8,574,730	18,099	8,592,829
1904	7,843,089	16,051	7,859,140

NEW BESSEMER STEEL CASTING PLANTS.

No new standard Bessemer plants were built in 1904. Nor was work commenced on any new standard Bessemer plants during that year. A number of works to make steel by the Tropenas process were, however, completed and put in operation in 1904; also one plant to make steel by the Bookwalter process and one plant to make steel in a special Bessemer converter.

The new Tropenas plants which were built and put in operation in 1904 were as follows: Watertown Arsenal, Watertown, Mass., one 2-long-ton converter, first steel made March 25, 1904; Massachusetts Steel Casting Company, Everett, Mass., one 2-long-ton converter, first steel made December 29, 1904; Providence Steel Casting Company, Providence, R. I., one 2-long-ton converter, first steel made in May, 1904; foundations are now ready for an additional 2-long-ton converter, which may be completed in 1905. United States navy-yard, Brooklyn, N. Y., one 2-long-ton converter, first steel made December 19, 1904; Southern Steel Works, Chattanooga, Tenn., one 2-long-ton converter, first steel made December 1, 1904. In addition to the above, Isaac G. Johnson & Co., (Incorporated), of Spuyten Duyvil, N. Y., added one 2-long-ton Tropenas converter to its plant in the summer of 1904, and its works are now equipped with two 2-long-ton converters.

The new plant to make steel by the Bookwalter process was erected by the Brylgon Steel Casting Company, at Newcastle, Del. It is equipped with two 2-long-ton converters. Steel was first made on September 22, 1904. The plant to make steel in a special converter was built by the Milwaukee Steel Foundry Company, at Milwaukee, Wis. Steel was first made on March 15, 1904. The converter has a capacity of 1 ton at each blow.

All the plants enumerated above make a specialty of steel castings, although occasionally a few ingots are made. Some of these ingots are used in the production of forgings.

PRODUCTION OF OPEN-HEARTH STEEL.

The total production of open-hearth steel ingots and direct castings in the United States in 1904 was 5,908,166 long tons, against 5,829,911 tons in 1903, an increase of 78,255 tons, or over 1.3 per cent. While this increase was not so great as had been looked for, it should be remembered that any increase at all in a year which witnessed a general reaction in business, and especially in the iron trade, marks an important advance in the open-hearth branch of our iron and steel industries.

The following table gives the production of open-hearth steel ingots and castings, by States, since 1899, in long tons:

Production of open-hearth steel ingots and castings in the United States, 1899–1904, by States.

[Long tons.]

State.	1899.	1900.	1901	1902.	1903.	1904.
New England	57,124	74,522	170,876	179,923	169,209	195,901
New York and New Jersey	61,461	67,361	82,985	92,763	104,598	165,986
Pennsylvania	2,393,811	2,699,502	3,594,763	4,375,364	4,442,730	4,306,498
Ohio	117,458	130,191	184,943	278,854	369,349	480,906
Illinois	246,183	285,551	398,522	435,461	422,919	358,215
Other States	71,279	141,008	224,220	325,364	321,106	400,660
Total	2,947,316	3,398,135	4,656,309	5,687,729	5,829,911	5,908,166

The open-hearth steel made in 1904, including both ingots and castings, was produced by 116 works in 16 States—Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Maryland, Tennessee, Alabama, Ohio, Indiana, Illinois, Wisconsin, Missouri, Colorado, and California. One hundred and eleven works in 17 States made open-hearth steel in 1903, and 98 works in 16 States made open-hearth steel in 1902.

The production of open-hearth steel ingots in 1904, excluding castings, the latter to be noticed hereafter, amounted to 5,605,332 long tons, against 5,429,563 long tons in 1903, an increase of 175,769 long tons.

PRODUCTION OF BASIC AND ACID OPEN-HEARTH STEEL INGOTS AND CASTINGS.

In the following table is given the production, by States, of both basic and acid open-hearth steel ingots and castings in 1904. The production of open-hearth steel by the basic and acid processes was first separately ascertained by the American Iron and Steel Association for the year 1896.

Production of basic and acid open-hearth steel ingots and castings in the United States in 1904, by States.

[Long tons.]

State.	Basic open-hearth steel.	Acid open-hearth steel.	Total.
New England	147,390	48,511	195,901
New York and New Jersey	139,791	26,195	165,986
Pennsylvania	3,667,673	638,825	4,306,498
Ohio	427,948	52,958	480,906
Illinois	341,073	17,142	358,215
Other States	382,492	18,168	400,660
Total for 1904	5,106,367	801,799	5,908,166
Total for 1903	4,734,913	1,094,998	5,829,911
Total for 1902	4,496,533	1,191,196	5,687,729
Total for 1901	3,618,993	1,037,316	4,656,309
Total for 1900	2,545,091	853,044	3,398,135
Total for 1899	2,080,426	866,890	2,947,316
Total for 1898	1,569,412	660,880	2,230.292
Total for 1897	1,056,043	552,628	1,608,671
Total for 1896	776,256	522,444	1,298,700

In 1903 4,734,913 tons of open-hearth steel were made by the basic process and 1,094,998 tons were made by the acid process, while in 1904 the production by the basic process amounted to 5,106,367 tons and by the acid process to 801.799 tons. A loss in production by the acid process in 1904 of 293,199 tons is indicated by these figures, but they also show a gain of 371,454 tons in the production of basic steel. This gain is less than the gain of 442,378 tons in 1904 in the production of basic pig iron. In 1902 there were made 4,496,533 tons of open-hearth steel by the basic process and 1,191,196 tons by the acid process. These figures show a steady decline in the production of acid steel.

PRODUCTION OF OPEN-HEARTH STEEL INGOTS AND CASTINGS.

The following table gives separately the total production of open-hearth steel ingots and castings from 1898 to 1904:

Production of open-hearth steel ingots and castings, 1898–1904.

[Long tons.]

Year.	Ingots.	Castings.	Total.
1898	2,109,705	120,587	2,230.292
1899	2,777,587	169,729	2,947,316
1900	3,220,644	177,491	3,398,135
1901	4,354,687	301,622	4,656,309
1902	5,319,850	367,879	5.687,729
1903	5,429,563	400,348	5,829,911
1904	5,605,332	302,834	5,908,166

PRODUCTION OF BASIC AND ACID OPEN-HEARTH STEEL INGOTS.

The following table gives the production of basic and acid open-hearth steel ingots in the United States from 1898 to 1904, direct castings being omitted. A table giving the production of basic and acid open-hearth steel castings will be found on this page.

Production of basic and acid open-hearth steel ingots, 1898–1904.

[Long tons.]

Year.	Basic open-hearth ingots.	Acid open-hearth ingots.	Total.
1898	1,540,952	568,753	2,109,705
1899	2,040,737	736,850	2,777,587
1900	2,502,447	718,197	3,220,644
1901	3,524,052	830,635	4,354,687
1902	4,384,129	935,721	5,319,850
1903	4,600,034	829,529	5,429,563
1904	5,007,448	597,884	5,605,332

PRODUCTION OF BASIC AND ACID OPEN-HEARTH STEEL CASTINGS.

The total production of open-hearth steel castings in 1904, as already stated, amounted to 302,834 long tons, of which 98,919 tons were made by the basic process and 203,915 tons were made by the acid process. In 1903 the production of open-hearth steel castings amounted to 400,348 tons, of which 134,879 tons were made by the basic process and 265,469 tons by the acid process. The decrease in the production of castings in 1904, as compared with 1903, amounted to 97,514 tons, the decline in basic castings amounting to 35,960 tons and in acid castings to 61,554 tons.

The production of open-hearth steel castings was first separately ascertained by the American Iron and Steel Association for the year 1898. The following table gives the production by States in each year since this separation was made:

Production of basic and acid open-hearth steel castings in 1904, by States.

[Long tons.]

State	Basic castings.	Acid castings.	Total.
New England, New York, and New Jersey	17,193	27,285	44,478
Pennsylvania	5,831	128,579	134,410
Ohio, Indiana, Illinois, and other States	75,895	48,051	123,946
Total for 1904	98,919	203,915	302,834
Total for 1903	134,879	265,469	400,348
Total for 1902	112,404	255,475	367,879
Total for 1901	94,941	206,681	301,622
Total for 1900	42,644	134,847	177,491
Total for 1899	39,689	130,040	169,729
Total for 1898			

In addition to the States named in the table Massachusetts, Connecticut, Tennessee, Alabama, Wisconsin, Missouri, and California made open-hearth steel castings in 1904.

The following table gives the production of open-hearth steel castings, by States, since 1898:

Production of open-hearth steel castings, 1898–1904, by States.

[Long tons.]

State.	1898.	1899.	1900.	1901.	1902.	1903.	1904.
New England, New York, and New Jersey	14,657	21,640	21,883	37,154	37,041	36,094	44,478
Pennsylvania	47,270	69,996	78,584	108,486	152,399	182,021	134,410
Ohio, Indiana, Illinois, and other States	58,660	78,093	77,024	155,982	178,439	182,233	123,946
Total	120,587	169,729	177,491	301,622	367,879	400,348	302,834

PRODUCTION OF CRUCIBLE STEEL.

The production of crucible steel in the United States in 1904 amounted to 83,391 long tons, against 102,434 tons in 1903, a decrease of 19,043 tons, or 18.5 per cent. Eight States made crucible steel in 1904, namely, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Indiana, Illinois, and Wisconsin. The direct castings produced in 1904, included above, amounted to 4,308 tons, against 5,409 tons in 1903. Pennsylvania made 60,815 tons of crucible steel ingots and castings in 1904, against 75,437 tons in 1903. No other State made over 8,500 tons in 1904 or 10,500 tons in 1903. With the exception of New Jersey, all the States named made crucible steel castings as well as ingots in 1904.

The following table gives separately the production of crucible steel ingots and castings from 1898 to 1904, in long tons:

Production of crucible steel ingots and castings, 1898–1904.

[Long tons.]

Year.	Ingots.	Castings.	Total.
1898	85,512	4,235	89,747
1899	97,713	3,500	101,213
1900	96,573	3,989	100,562
1901	94,586	3,927	98,513
1902	107,817	4,955	112,772
1903	97,025	5,409	102,434
1904	79,083	4,308	83,391

PRODUCTION OF MISCELLANEOUS STEEL.

The production of steel in the United States in 1904 by various minor processes amounted to 9,190 long tons, against 9,804 tons in

1903. Three States made steel in 1904 by minor processes, namely, New Jersey, Pennsylvania, and Indiana. Blister, puddled, and "patented" steel, including "patented" steel castings, are included in these figures.

PRODUCTION OF ALL KINDS OF STEEL.

The production of all kinds of steel ingots and castings in 1904 amounted to 13,859,887 long tons, against 14,534,978 tons in 1903, a decrease of 675,091 tons, or over 4.6 per cent, and against 14,947,250 tons in 1902. Of the total production in 1904, 13,529,676 tons were ingots and 330,211 were direct castings. The maximum production of steel ingots and castings was reached in 1902; the year of next highest production was 1903. Puddled, "patented," and all other kinds of steel are included.

PRODUCTION OF ALL KINDS OF RAILS.

The production of all kinds of rails in 1904 amounted to 2,284,711 long tons, against 2,992,477 tons in 1903, a decrease of 707,766 tons, or 23.6 per cent. The production in 1902 was 2,947,933 tons. In the following table the production of all kinds of rails in 1904 is given by States.

Production of all kinds of rails in 1904, by States.

[Long tons.]

State.	Bessemer.	Open-hearth.	Iron.	Total.
Pennsylvania	801,657	20,451	....	822,108
Other States	1,336,300	125,432	871	1,462,603
Total	2,137,957	145,883	871	2,284,711

Twenty-six plants in 13 States rolled or rerolled rails in 1904, as follows: New York, 2; Pennsylvania, 5; Maryland, 3; West Virginia, 2; Tennessee, 1; Georgia, 1; Alabama, 3; Ohio, 3; Illinois, 2; Wisconsin, 1; Kansas, 1; Colorado, 1; and Wyoming, 1. The year of maximum production of all kinds of rails was 1903; the year of next largest production was 1902.

PRODUCTION OF BESSEMER STEEL RAILS.

The production of Bessemer steel rails in 1904 amounted to 2,137,957 long tons, against 2,946,756 tons in 1903, a decrease of 808,799 tons, or over 27.4 per cent. The maximum production of Bessemer steel rails was reached in 1903. In the following table the production of Bessemer steel rails is given by States from 1899 to 1904. Rails rolled from purchased blooms, crop ends, and "seconds," and rerolled or renewed rails are included. Renewed rails are rails that have been in use and are rolled down to smaller sections after reheating

Production of Bessemer steel rails, 1899–1904, by States.

[Long tons.]

Bessemer steel rails.	1899.	1900.	1901.	1902.	1903.	1904.
Pennsylvania	1,224,807	1,195,255	1,406,008	1,148,425	1,186,284	801,657
Other States	1,045,778	1,188,399	1,464,808	1,786,967	1,760,472	1,336,300
Total	2,270,585	2,383,654	2,870,816	2,935,392	2,946,756	2,137,957

In addition to Pennsylvania the States which made Bessemer rails in 1904 were New York, Maryland, West Virginia, Georgia, Ohio, Illinois, Wisconsin, Kansas, Colorado, and Wyoming.

The production of Bessemer steel rails by the makers of Bessemer steel ingots, included above, amounted to 2,084,688 long tons in 1904, 2,873,228 tons in 1903, 2,876,293 tons in 1902, 2,836,273 tons in 1901, 2,361,921 tons in 1900, and 2,240,767 tons in 1899. In the following table we give the total production of all kinds of Bessemer steel rails from 1899 to 1904, the rails rolled by makers of domestic ingots being separated from those rolled by companies which did not operate Bessemer converters.

Production of all kinds of Bessemer steel rails, 1899–1904.

[Long tons.]

Bessemer steel rails.	1899.	1900.	1901.	1902.	1903.	1904.
By makers	2,240,767	2,361,921	2,836,273	2,876,293	2,873,228	2,084,688
By all others	29,818	21,733	34,543	59,099	73,528	53,269
Total	2,270,585	2,383,654	2,870,816	2,935,392	2,946,756	2,137,957

Twenty-two plants rolled or rerolled Bessemer steel rails in 1904, of which 5 were located in Pennsylvania, 3 in Maryland, 2 in West Virginia, 3 in Ohio, 2 in Illinois, 2 in New York, and 1 each in Georgia, Wisconsin, Kansas, Colorado, and Wyoming.

PRODUCTION OF OPEN-HEARTH AND IRON RAILS.

The total production of open-hearth steel rails in the United States in 1904 was 145,883 long tons, against 45,054 tons in 1903, 6,029 tons in 1902, 2,093 tons in 1901, and 1,333 tons in 1900. The maximum production of open-hearth rails was reached in 1904. Prior to 1903 the year of next highest production was 1881, when 22,515 tons were made. Alabama rolled almost all the open-hearth rails that were made in 1904, Pennsylvania and Colorado being the only other producers. Over 116,000 tons of the open-hearth rails made weighed between 45 and 85 pounds per yard and over 8,000 tons weighed 85 pounds or over; the remainder, over 21,000 tons, weighed less than 45 pounds.

The production of iron rails in 1904 was 871 tons, all rolled in Tennessee and Alabama, and all weighing less than 45 pounds to the yard. In 1903 the production of iron rails was 667 tons, against 6,512 tons in 1902, 1,730 tons in 1901, 695 tons in 1900, 1,592 tons in 1899, and 3,319 tons in 1898. The maximum production of iron rails was reached in 1872, 808,866 tons.

WEIGHT OF ALL KINDS OF RAILS.

The production of rails weighing under 45 pounds to the yard in 1904 shows an increase of 70,621 tons as compared with 1903, but the production of rails weighing 45 pounds and less than 85 pounds shows a decrease of 282,411 tons as compared with 1903. The great falling off in the production of rails in 1904 as compared with 1903 was, however, in sections weighing 85 pounds and over to the yard, in which the decrease amounted to 495,976 tons.

The following table gives the production of all kinds of rails in 1904, according to the weight of the rails per yard. Street rails are included in the total production of rails. Prior to 1897 the weight per yard of rails produced was not ascertained by the American Iron and Steel Association.

Production of all kinds of rails in United States, 1897–1904, by kind of rails and by weight per yard.

[Long tons.]

Kind of rails.	Under 45 pounds.	45 pounds and less than 85.	85 pounds and over.	Total.
Bessemer steel rails	269,743	1,204,356	663,858	2,137,957
Open-hearth steel rails	21,269	116,321	8,293	145,883
Iron rails	871	....	....	871
Total for 1904	291,883	1,320,677	672,151	2,284,711
Total for 1903	221,262	1,603,088	1,168,127	2,992,477
Total for 1902	261,887	2,040,884	645,162	2,947,933
Total for 1901	155,406	2,225,411	493,822	2,874,639
Total for 1900	157,531	1,626,093	602,058	2,385,682
Total for 1899	133,836	1,559,340	579,524	2,272,700
Total for 1898	123,881	1,404,150	453,210	1,981,241
Total for 1897	88,896	1,223,435	335,561	1,647,892

In addition to the rails rolled, 37,776 tons of iron and steel rails were imported in 1904. During the same year 416,250 tons were exported. In 1903 the exports of rails amounted to 30,837 tons and the imports to 95,555 tons. Virtually all the imports and exports of rails are steel rails.

PRODUCTION OF STRUCTURAL SHAPES.

The statistics of iron and steel structural shapes embrace the production of beams, beam girders, zee bars, tees, channels, angles, and other structural forms, but they do not include plates or girders made from plates. Plates are provided for under other classifications, and in the general statistics of plates are included all plates cut to specifications.

The total production of strictly structural shapes in 1904 was 949,146 long tons, against 1,095,813 tons in 1903, a decrease of 146,667 tons. Of the total production in 1904, about 941,127 tons were rolled from steel and about 8,019 tons from iron. The production of structural shapes in 1903 and 1904, by States, was as follows:

Production of iron and steel structural shapes in United States in 1903 and 1904, by States.

[Long tons.]

State.	1903.	1904.	State.	1903.	1904.
New York and New Jersey	32,884	47,657	Indiana, Illinois, Wyoming, and California	24,363	48,038
Pennsylvania	1,004,375	829,167			
Delaware, Alabama, and Ohio	34,191	24,284	Total	1,095,813	949,146

Pennsylvania made over 87.3 per cent of the total production in 1904, against over 91 per cent in 1903; New Jersey over 4.3 per cent, against over 3 per cent in 1903; and Indiana over 3.1 per cent, against less than 1 per cent in 1903. No other State made 2.6 per cent in 1904 or 3 per cent in 1903.

PRODUCTION OF WIRE RODS.

The production of iron and steel wire rods in the United States in 1904 amounted to 1,699,028 long tons, against 1,503,455 tons in 1903, 1,574,293 tons in 1902, 1,365,934 tons in 1901, and 846,291 tons in 1900, showing an increase of 195,573 tons in 1904 as compared with 1903, or over 13 per cent. Of the total production in 1904, 1,697,862 tons were steel rods and 1,166 tons were iron rods. In 1903 the steel wire rods rolled amounted to 1,503,425 tons and the iron rods to 30 tons. The maximum production was reached in 1904. The following table gives the total production of iron and steel wire rods, by States, in the last four years:

Production of wire rods in United States, 1901–1904, by States.

[Long tons.]

State.	1901.	1902.	1903.	1904.
Massachusetts, Connecticut, Rhode Island, New York, and New Jersey	176,101	201,653	240,024	228,289
Pennsylvania, Kentucky, Alabama, and Ohio	808,716	950,260	897,891	973,801
Indiana, Illinois, and Colorado	381,117	422,380	365,540	496,938
Total	1,365,934	1,574,293	1,503,455	1,699,028

Pennsylvania made the largest quantity of wire rods in 1904, with Illinois second, Ohio third, and Massachusetts fourth. Eight other States—Indiana, Colorado, Kentucky, New York, New Jersey, Connecticut, Alabama, and Rhode Island—also rolled wire rods in 1904 in the order named. All the States mentioned also rolled iron or steel wire rods in 1903.

PRODUCTION OF WIRE NAILS.

The production of wire nails in the United States in 1904 amounted to 11,926,661 kegs of 100 pounds, as compared with 9,631,661 kegs in 1903, an increase of 2,295,000 kegs. The following table gives the production of wire nails, by States, in 1902, 1903, and 1904, in kegs of 100 pounds.

Production of wire nails in United States, 1902–1904, by States.

[Kegs of 100 pounds.]

State.	1902.	1903.	1904.
New Hampshire, Massachusetts, Rhode Island, and Connecticut.	309,651	230,264	247,157
New York, New Jersey, Pennsylvania, Ohio, and Alabama	7,345,483	6,540,452	7,791,661
Maryland, West Virginia, Kentucky, Indiana, and Illinois	3,160,899	2,525,474	3,236,120
Michigan, Wisconsin, Colorado, and California	166,213	335,471	651,723
Total	10,982,246	9,631,661	11,926,661

The wire nails produced in 1904 were all made of steel, and were turned out by 56 works, as compared with 57 in 1903, 62 in 1902, 61 in 1901, 56 in 1900, and 59 in 1899. For 1903 it was necessary to estimate the production of two wire nail plants and for 1904 to estimate the production of one plant. The maximum production of wire nails was reached in 1904.

PRODUCTION OF CUT NAILS.

The statistics of the production of iron and steel cut nails and cut spikes embrace only standard sizes of nails and spikes cut from plates. They do not embrace railroad and other forged spikes, wire nails of any size, machine-made horseshoe nails, cut tacks, or hob, clout, basket, shoe, or other small sizes of nails.

The production of cut nails and spikes cut from plates in 1904 was 1,283,362 kegs of 100 pounds each, against 1,435,893 kegs in 1903, a decrease of 152,531 kegs. In 1886 the maximum production of 8,160,973 kegs was reached. In 1904 the production of wire nails exceeded that of cut nails by 10,643,299 kegs, in 1903 by 8,195,768 kegs, in 1902 by 9,348,484 kegs, in 1901 by 8,261,582 kegs, in 1900 by 5,660,485 kegs, in 1899 by 5,713,790 kegs, and in 1898 by 5,846,254 kegs.

Eleven States made cut nails in 1904 and 11 in 1903. The following table gives the production of iron and steel cut nails by States from 1899 to 1904, in kegs of 100 pounds. The wire-nail production is added to the table. Except West Virginia and Kentucky all the States which produced cut nails in 1904 decreased their production as compared with 1903. Of the total production of cut nails in 1904 about 887,675 kegs were made from steel plates and about 395,687 kegs from iron plates.

Production of cut nails in the United States, 1899–1904, by States.

[Kegs of 100 pounds.]

State.	1899.	1900.	1901.	1902.	1903.	1904.
Pennsylvania	920,133	777,611	833,469	752,729	725,000	698,326
Ohio	386,215	261,216	123,788	99,938	59,240	54,038
West Virginia and Indiana	178,006	168,469	150,222	271,362	274,808	245,997
Massachusetts and New Jersey	149,700	155,968	179,474	167,963	143,898	128,943
Illinois, Maryland, Virginia, and Kentucky	255,286	193,230	240,657	304,990	223,447	148,058
Wisconsin, Colorado, and California	15,000	17,000	14,630	36,780	9,500	8,000
Total cut nails	1,904,340	1,573,494	1,542,240	1,633,762	1,435,893	1,283,362
Total wire nails	7,618,130	7,233,979	9,803,822	10,982,246	9,631,661	11,926,661
Grand total	9,522,470	8,807,473	11,346,062	12,616,008	11,067,554	13,210,023

PRODUCTION OF PLATES AND SHEETS.

The production of iron and steel plates and sheets in the United States in 1904, excluding nail plate, amounted to 2,421,398 long tons, against 2,599,665 tons in 1903, a decrease of 178,267 tons, or over 6.8 per cent. Of the total production in 1904 about 2,353,685 tons were rolled from steel and about 67,713 tons from iron. Skelp iron and steel are not included in the statistics of plates and sheets, but are classed with hoops, bars, etc., elsewhere. The following table gives the production, by States, of all kinds of iron and steel plates and sheets in 1902, 1903, and 1904.

Production of iron and steel plates and sheets in the United States, 1902–1904, by States.

[Long tons.]

State.	1902.	1903.	1904.
New England, New York, and New Jersey	9,240	12,560	14,599
Pennsylvania	1,808,207	1,771,745	1,555,941
Delaware and Maryland	34,282	23,703	23,956
West Virginia	67,072	56,361	108,964
Kentucky and Alabama	56,823	40,635	44,845
Ohio	404,902	403,705	490,192
Indiana, Illinois, Michigan, Missouri, Wisconsin, Colorado, and California	284,883	290,956	182,901
Total	2,665,409	2,599,665	2,421,398

Fourteen States rolled plates and sheets in 1904, against 15 States in 1903. Of the total production of plates and sheets in 1904 Pennsylvania made over 64.2 per cent, against over 68 per cent in 1903; Ohio over 20.2 per cent, against over 15.5 per cent in 1903; West Virginia over 4.5 per cent, against over 2.1 per cent in 1903; and Illinois over 3.7 per cent, against over 5.7 per cent in 1903. Indiana, Kentucky, Maryland, Delaware, Missouri, Massachusetts, Alabama, New Jersey, New York, and California also made plates and sheets in 1904 in the order named. Connecticut, which rolled plates and sheets in 1903, was not a producer in 1904. Michigan and Wisconsin, which made plates and sheets in 1902, were not producers in 1903 or 1904.

The production of iron and steel nail plate in 1904 was 61,601 tons, of which about 42,182 tons were steel and about 19,419 tons were iron. These figures are not included in the foregoing table.

PRODUCTION OF BLACK PLATES, OR SHEETS, FOR TINNING.

The production of black plates, or sheets, for tinning in 1904, which is included in the preceding table, amounted to 472,569 long tons, against 490,652 tons in 1903, a decrease of 18,083 tons, or over 3.6 per cent. Of the production in 1904 Pennsylvania made over 53.4 per cent, against over 52 per cent in 1903. Ohio, Indiana, West Virginia, Illinois, Maryland, and Missouri also made black plates for tinning in 1903 and 1904 in the order named. Almost all the black plates made in 1904 were rolled from steel; only a few thousand tons were rolled from iron.

PRODUCTION OF TIN PLATES AND TERNE PLATES.

The American Iron and Steel Association estimates the production of tin plates and terne plates in the United States in 1904 as amounting to 458,000 long tons, as compared with an estimated production of 480,000 tons in 1903, a decrease of 22,000 tons, or over 4.5 per cent.

PRODUCTION OF MISCELLANEOUS ROLLED PRODUCTS.

In the following table is given the production by States in 1903 and 1904 of merchant bars, skelp, spike rods, bolt rods, splice bars, hoops, bands, cotton ties, strips, rolled axles, rolled armor plate, and other forms of finished rolled iron and steel for which statistics have not been given in preceding pages.

Production of miscellaneous rolled products in 1903 and 1904.

[Long tons.]

State.	1903.	1904.	State.	1903.	1904.
Maine and Massachusetts	30,432	31,858	Ohio	617,221	572,604
Rhode Island and Connecticut	67,546	71,498	Indiana	207,386	183,155
New York	166,693	147,561	Illinois	364,633	289,904
New Jersey	75,981	56,714	Michigan	77,593	47,326
Pennsylvania	2,700,359	2,634,712	Wisconsin	134,649	127,536
Delaware and Maryland	33,330	19,365	Missouri	62,870	50,370
Virginia	41,043	30,502	Colorado and Wyoming	44,583	29,195
West Virginia	189,098	174,572	Washington, Oregon, and California	33,518	30,908
Kentucky	30,233	26,331	Total	4,952,185	4,597,497
Tennessee and Georgia	22,939	28,923			
Alabama	52,078	44,463			

Of the total production of the above products in 1904 about 2,934,601 tons were steel and about 1,662,896 tons were iron.

PRODUCTION OF ALL ROLLED IRON AND STEEL.

The phrase "rolled iron and steel" includes all iron and steel rolled into finished forms. Forged armor plate, hammered axles, and other forgings are not included, nor such intermediate rolled forms as muck bars, billets, tin plate, bars, sheet bars, etc.

The production of all kinds of iron and steel in finished forms in the United States in 1904 amounted to 12,013,381 long tons, against 13,207,697 tons in 1903, a decrease of 1,194,316 tons, or over 9 per cent. Of the total production in 1904 about 10,253,297 tons were rolled from steel and about 1,760,084 tons from iron. Twenty-seven States rolled either iron or steel or both iron and steel in 1904, against 25 States in 1903. The following table gives the total production by States of all kinds of finished rolled iron and steel in 1903 and 1904:

Production of all kinds of finished rolled iron and steel in 1903 and 1904, by States.

[Long tons.]

State.	1903.	1904.	State.	1903.	1904.
Maine and Massachusetts	157,627	158,085	Alabama	112,245	195,049
Rhode Island and Connecticut	131,182	108,575	Ohio	1,883,643	1,517,054
New York	255,905	486,870	Indiana	405,076	409,739
New Jersey	145,282	140,572	Illinois	1,481,562	1,241,166
Pennsylvania	7,171,982	6,461,681	Michigan	77,593	47,326
Delaware	47,673	28,521	Wisconsin	204,685	184,511
Maryland	372,009	286,553	Missouri	75,470	59,210
Virginia	43,631	30,746	Colorado and Wyoming	169,409	169,649
West Virginia	252,331	295,939	Kansas, Washington, Oregon, and California	38,904	40,369
Kentucky	158,280	120,534	Total	13,207,697	12,013,381
Tennessee and Georgia	23,208	31,232			

Pennsylvania made over 53.7 per cent of the total production of rolled iron and steel in 1904, against over 54 per cent in 1903; Ohio over 12.6 per cent in 1904, against over 14 per cent in 1903; Illinois over 10.3 per cent in 1904, against over 11 per cent in 1903; New York over 4 per cent in 1904, against over 1.9 per cent in 1903; and Indiana over 3.4 per cent in 1904, against over 3 per cent in 1903. No other State made over 2.5 per cent in 1904 or over 2.9 per cent in 1903. Minnesota did not roll either iron or steel in 1903 or 1904, but it made a small quantity of direct steel castings in both years.

TOTAL PRODUCTION OF FINISHED ROLLED IRON AND STEEL, 1887-1904.

The total production of iron and steel rolled into finished forms in the United States from 1887 to 1904 is as follows. Prior to 1892 structural shapes were included with bars, hoops, etc.:

Production of all kinds of finished rolled iron and steel, 1887–1904.

[Long tons.]

Year.	Iron and steel rails.	Plates and sheets, except nail plate.	Wire rods.	Structural shapes.	Nail plate.	Bars, hoops, and all other.	Total.
1887	2,139,640	603,355	....	....	308,432	2,184,279	5,235,706
1888	1,403,700	609,827	279,769	....	289,891	2,034,162	4,617,349
1889	1,522,204	716,496	363,851	....	259,409	2,374,968	5,236,928
1890	1,885,307	809,981	457,099	....	251,828	2,618,660	6,022,875
1891	1,307,176	678,927	536,607	....	223,312	2,644,941	5,390,963
1892	1,551,844	751,460	627,829	453,957	201,242	2,579,482	6,165,814
1893	1,136,458	674,345	537,272	387,307	136,113	2,104,190	4,975,685
1894	1,021,772	682,900	673,402	360,305	108,262	1,795,570	4,642,211
1895	1,306,135	991,459	791,130	517,920	95,085	2,487,845	6,189,574
1896	1,122,010	965,776	623,986	495,571	72,137	2,236,361	5,515,841
1897	1,647,892	1,207,286	970,736	583,790	94,054	2,497,970	7,001,728
1898	1,981,241	1,448,301	1,071,683	702,197	70,188	3,239,760	8,513,370
1899	2,272,700	1,903,505	1,036,398	850,376	85,015	4,146,425	10,294,419
1900	2,385,682	1,794,528	846,291	815.161	70,245	3,575,536	9,487,443
1901	2,874,639	2,254,425	1,365,934	1,013,150	68,850	4,772,329	12,349,327
1902	2,947,933	2,665,409	1,574,293	1,300,326	72,936	5,383,219	13,944,116
1903	2,992,477	2,599,665	1,503,455	1,095,813	64,102	4,952,185	13,207,697
1904	2,284,711	2,421,398	1,699,028	949,146	61,601	4,597,497	12,013,381

COMPARATIVE PRODUCTION OF FINISHED ROLLED IRON AND STEEL.

In 1890 the production of finished rolled steel amounted to 3,504,681 long tons, as compared with 2,518,194 tons of finished rolled iron; in 1889 to 2,927,656 tons of steel, as compared with 2,309,272 tons of iron; and in 1888 to 2,464,086 tons of steel, as compared with 2,153,263 tons of iron. Prior to 1888 complete statistics of the production of rolled steel were not collected by the American Iron and Steel Association.

From 1890 to 1904 the increase in the production of finished rolled steel amounted to 6,748,616 tons, or over 192 per cent, while the decrease in the production of finished rolled iron amounted to 758,110 tons, or over 30 per cent.

The following table gives approximately by States the total production of finished rolled steel in 1904 as compared with the total production of finished rolled iron in the same year. Similar comparative statistics from 1891 to 1903, inclusive, are not available.

Comparative production of finished rolled iron and steel in 1904, by States.

[Long tons.]

State.	Iron.	Steel.	Total.
Maine and Massachusetts	13,690	144,395	158,085
Rhode Island and Connecticut	23,889	84,686	108,575
New York	89,376	397,494	486,870
New Jersey	27,047	113,525	140,572
Pennsylvania	855,453	5,606,228	6,461,681
Delaware	15,903	12,618	28,521
Maryland	2,800	283,753	286,553
Virginia	27,726	3,020	30,746
West Virginia	9,536	286,403	295,939
Kentucky, Tennessee, and Georgia	65,163	86,603	151,766
Alabama	38,058	156,991	195,049
Ohio	198,734	1,318,320	1,517,054
Indiana	184,155	225,584	409,739
Illinois	98,192	1,142,974	1,241,166
Michigan and Wisconsin	17,549	214,288	231,837
Kansas and Missouri	48,374	15,735	64,109
Colorado and Wyoming	10,018	159,631	169,649
Washington, Oregon, and California	34,421	1,049	35,470
Total	1,760,084	10,253,297	12,013,381

In the following table the approximate production of leading articles of finished rolled steel in 1904 is given as compared with the approximate production in the same year of like articles of finished rolled iron. All miscellaneous products are included:

Comparative production of leading articles of finished rolled iron and steel in 1904.

[Long tons.]

Article.	Iron.	Steel.	Total.
Rails	871	2,283,840	2,284,711
Structural shapes	8,019	941,127	949,146
Plates and sheets	67,713	2,353,685	2,421,398
Nail plate	19,419	42,182	61,601
Wire rods	1,166	1,697,862	1,699,028
Merchant bars, skelp, spike rods, splice bars, and other finished rolled products	1,662,896	2,934,601	4,597,497
Total	1,760,084	10,253,297	12,013,381

PRODUCTION OF IRON BLOOMS AND BILLETS.

In 1902, 1903, and 1904 there were no forges in operation in the United States for the manufacture of blooms and billets from the ore. In 1901 the blooms and billets so made amounted to 2,310 long tons, against 4,292 tons in 1900 and 3,142 tons in 1899. All the ore blooms produced since 1897 were made by the Chateaugay Ore and Iron Company, of Plattsburg, N. Y., at its Standish Works, which were, however, idle in 1902, 1903, and 1904. All the Catalan forges in the South have been virtually abandoned; none are now active.

The iron blooms produced in forges from pig iron and scrap in 1904, and which were for sale and not for the consumption of the makers, amounted to 5,743 tons, against 9,940 tons in 1903, 12,002 tons in 1902, 8,237 tons in 1901, 8,655 tons in 1900, 9,932 tons in 1899, 6,345 tons in 1898, 7,159 tons in 1897, and 6,494 tons in 1896, all made in New York, Pennsylvania, and Maryland.

PRODUCTION OF IRON AND STEEL IN ALLEGHENY COUNTY, PA.

The following table gives the number of blast furnaces and completed rolling mills and steel works and the production of pig iron and crude steel, rails, structural shapes, plates and sheets, miscellaneous rolled products, and all finished rolled iron and steel in Allegheny County, Pa., from 1901 to 1904:

Production of pig iron, crude steel, rails, etc., in Allegheny County, Pa., 1901–1904.

[Long tons.]

	1901.	1902.	1903.	1904.
Furnaces built and building .... number..	37	40	41	42
Production of pig iron	3,690,011	4,260,769	4,211,569	4,383,169
Rolling mills and steel works .... number..	63	66	65	64
Production of Bessemer steel	2,883,595	3,094,175	2,748,833	2,487,412
Production of open-hearth steel	2,199,191	2,503,245	2,604,349	2,737,560
Production of all other steel	56,053	62,888	51,195	36,408
Total production of steel	5,138,839	5,660,308	5,404,377	5,261,380
Production of all kinds of rails	711,031	712,286	749,953	586,210
Production of structural shapes	617,308	773,144	689,849	601,025
Production of plates and sheets	850,285	1,010,650	945,327	839,015
Production of other rolled products	1,816,587	1,977,179	1,797,795	1,707,545
Production of all rolled products	3,995,211	4,473,259	4,182,924	3,733,795

STEEL VESSELS BUILT IN THE CALENDAR YEAR 1904.

The following table, furnished by the Hon. Eugene T. Chamberlain, Commissioner of Navigation, shows the number and gross tonnage of the steel vessels launched in the United States and officially numbered during the calendar year 1904. Vessels for the United States Navy are not included:

Number and tonnage of steel vessels launched and officially numbered in the United States in the calendar year 1904, by ports and kinds.

Ports.	Sailing.		Steam.		Barges.		Total.	
	No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.	No.	Gross tonnage.
Boston, Mass			5	4,070	6	5,724	11	9,794
New London, Conn			1	20,718	4	4,000	5	24,718
New York, N. Y	4	8,996	[a]13	3,483			17	12,479
Newark, N. J			1	1,225			1	1,225
Perth Amboy, N. J			1	45	1	303	2	348
Philadelphia, Pa			19	33,267	2	1,908	21	35,175
Wilmington, Del			5	8,263	3	1,103	8	9,366
Baltimore, Md			4	1,801	2	1,052	6	2,853
Richmond, Va			3	4,634			3	4,634
Newport News, Va			1	1,462			1	1,462
Jacksonville, Fla			1	281			1	281
New Orleans, La			2	60			2	60
Pittsburg, Pa					1	479	1	479
Buffalo, N. Y			3	425	3	787	6	1,212
Cleveland, Ohio			6	31,277	1	894	7	32,171
Toledo, Ohio			5	2,258			5	2,258
Detroit, Mich			4	12,040	1	384	5	12,424
Grand Haven, Mich					1	420	1	420
Milwaukee, Wis					1	715	1	715
Chicago, Ill			4	7,538			4	7,538
San Francisco, Cal			2	1,113			2	1,113
Port Townsend, Wash			1	84			1	84
Total	4	8,996	81	134,044	26	17,769	111	160,809

[a] Including 1 vessel of 96 tons built of bronze.

During the calendar year 1903 there were 6 steel sailing vessels launched and numbered, with a gross tonnage of 11,766 tons; 119 steam steel vessels, with 279,781 tons; and 6 steel barges, with 4,293 tons; total number of vessels, 131, with 295,840 tons. There were no iron vessels launched in 1903 or 1904.

SUMMARY OF IRON, STEEL, ETC., STATISTICS FOR 1903 AND 1904.

Summary of iron, steel, etc., statistics for the United States for 1903 and 1904.

[Long tons, except as stated.]

Item.	1903.	1904.
Production of iron ore	35,019,308	27,644,330
Imports of iron ore	980,440	487,613
Production of bituminous coal	252,454,775	249,102,765
Production of Pennsylvania anthracite	66,613,454	65,318,490
Production of all kinds of coal	319,068,229	314,421,255
Shipments of Pennsylvania anthracite	59,362,831	57,492,522
Imports of coal for consumption	3,479,430	1,623,280
Domestic exports of coal	8,312,098	8,573,518
Production of coke ....short tons..	25,262,360	23,621,520
Production of pig iron	18,009,252	16,497,033
Production of spiegeleisen, ferromanganese, and ferrophosphorus, included in pig iron	192,661	220,392
Production of Bessemer steel	8,592,829	7,859,140
Production of open-hearth steel	5,829,911	5,908,166
Production of crucible steel	102,434	83,391
Production of blister and patented steel	9,804	9,190
Production of all kinds of steel	14,534,978	13,859,887
Production of open-hearth steel castings	400,348	302,834
Production of all kinds of steel castings	430,265	330,211
Production of Bessemer steel rails	2,946,756	2,137,957
Production of open-hearth steel rails	45,054	145,883
Production of iron rails	667	871
Production of all kinds of rails	2,992,477	2,284,711
Production of structural shapes	1,095,813	949,146
Production of iron and steel wire rods	1,503,455	1,699,028
Production of plate and sheet iron and steel, except nail plate	2,599,665	2,421,398
Production of bar, bolt, hoop, skelp, rolled axles, rolled armor plate, etc.	4,952,185	4,597,497
Production of all rolled iron and steel, including nail plate and excluding rails	10,215,220	9,728,670
Production of all rolled iron and steel, including both nail plate and rails.	13,207,697	12,013,381
Production of iron and steel cut nails and cut spikes..kegs of 100 pounds..	1,435,893	1,283,362
Production of iron and steel wire nails ....do....	9,631,661	11,926,661
Production of tin plates and terneplates	480,000	458,000
Production of ore, pig, and scrap blooms for sale	9,940	5,743
Imports of iron and steel ....foreign value..	$41,255,864	$21,621,970
Exports of iron and steel ....home value..	$99,035,865	$128,553,613
New railroad built (estimated for 1904) ....miles..	4,715	4,252
Tonnage of steel vessels built in the calendar year	295,840	160,809
Immigrants in the year ended December 31	937,371	808,967

STATISTICS OF THE CANADIAN IRON TRADE FOR 1904.

PRODUCTION OF PIG IRON IN CANADA.

The American Iron and Steel Association has received from the manufacturers the statistics of the production of pig iron in the Dominion of Canada in the calendar year 1904. They show an increase of 5,524 long tons, or a little over 2 per cent, as compared with 1903.

The total production of all kinds of pig iron in Canada in 1904 amounted to 270,942 long tons, against 265,418 tons in 1903, 319,557 tons in 1902, 244,976 tons in 1901, and 86,090 tons in 1900. In the first half of 1904 the production was 120,643 tons, and in the second half it was 150,299 tons, an increase of 29,656 tons. In 1904 of the total production 251,671 tons were made with coke and 19,271 tons with charcoal. About one-fourth of the total production was basic pig iron and a little less than one-tenth was Bessemer pig iron. Spiegeleisen and ferromanganese have not been made in Canada since 1899.

The following table gives the total production of all kinds of pig iron (including spiegeleisen and ferromanganese) in Canada from 1894 to 1904. Prior to 1894 the statistics of pig-iron production in Canada were not collected by the American Iron and Steel Association.

Production of pig iron in Canada, 1894–1904.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1894	44,791	1898	68,755	1902	319,557
1895	37,829	1899	94,077	1903	265,418
1896	60,030	1900	86,090	1904	270,942
1897	53,796	1901	244,976		

On December 31, 1904, the unsold stocks of pig iron in Canada amounted to 35,119 tons, as compared with 19,168 tons at the close of 1903, about 20,000 tons at the close of 1902, 59,472 tons at the close of 1901, and 12,465 tons at the close of 1900.

On December 31, 1904, Canada had 15 completed blast furnaces, of which 8 were in blast and 7 were idle. Of this total, 10 were equipped to use coke for fuel and 5 to use charcoal. In addition, 3 coke furnaces, upon which work had been suspended for some time, were partly erected on December 31.

During the first half of 1904 Canada had 10 of its completed furnaces in blast, and during the last half of the year it had the same number of furnaces running. Of the active furnaces in each half year, 7 were coke and 3 were charcoal furnaces.

PRODUCTION OF STEEL IN CANADA.

The American Iron and Steel Association has also received from the manufacturers the statistics of the production of steel ingots and castings and of finished rolled iron and steel in Canada in 1904.

The total production of steel ingots and castings in Canada in 1904 was 148,784 long tons, against 181,514 tons in 1903, a decrease of 32,730 tons. Bessemer and open-hearth steel ingots and castings were made in each year. Almost all the open-hearth steel reported in 1903 and 1904 was made by the basic process. The direct steel castings made in 1904 amounted to 6,505 tons. Canada has not made crucible steel prior to the present year.

The following table gives the production of all kinds of steel ingots and castings in Canada from 1894 to 1904:

Production of all kinds of steel ingots and castings in Canada, 1894–1904.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1894	25,685	1898	21,540	1902	182,037
1895	17,000	1899	22,000	1903	181,514
1896	16,000	1900	23,577	1904	148,784
1897	18,400	1901	26,084		

PRODUCTION OF FINISHED ROLLED IRON AND STEEL IN CANADA.

The following table gives the production of all kinds of iron and steel rolled into finished forms in Canada from 1895 to 1904:

Production of all kinds of finished rolled iron and steel in Canada, 1895–1904.

Year.	Quantity.	Year.	Quantity.	Year.	Quantity.
	Long tons.		*Long tons.*		*Long tons.*
1895	66,402	1899	110,642	1903	129,516
1896	75,043	1900	100,690	1904	180,038
1897	77,021	1901	112,007		
1898	90,303	1902	161,485		

The production of Bessemer and open-hearth steel rails in 1904 amounted to 36,216 long tons, against 1,243 tons in 1903; structural shapes, 447 tons, against 1,983 tons in 1903; cut nails made by rolling mills and steel works having cut-nail factories connected with their plants, 99,000 kegs of 100 pounds, against 118,686 kegs in 1903; plates and sheets, 3,102 tons, against 2,450 tons in 1903; all other finished rolled products, excluding muck and scrap bars, blooms, billets, sheet bars, and other unfinished forms, 135,243 tons, against 118,541 tons in 1903. The total quantity of all kinds of iron and steel rolled into finished forms in Canada in 1904 amounted to 180,038 tons, against

129,516 tons in 1903. Of the .180,038 tons of finished iron and steel reported for 1904 about 126,850 tons were rolled from steel and 53,188 tons from iron.

On December 31, 1904, there were 18 completed rolling mills and steel works in Canada. In addition 3 plants were being built and 2 plants were projected. Of the completed plants 2 were equipped for the manufacture of steel castings only, 5 for the manufacture of Bessemer or open-hearth steel ingots and rolled products, and 11 for the manufacture of rolled products only. Of the building plants 1 was being equipped for the manufacture of steel castings by a special process, 1 for the manufacture of open-hearth steel ingots only, and 1 for the manufacture of merchant bar iron, railway spikes, etc. One of the projected plants is to be equipped for the manufacture of skelp and bar iron and the other for the manufacture of wire rods.

Of the 18 completed rolling mills and steel works in Canada on December 31, 1904, 3 were located in Nova Scotia, 5 in Quebec, 9 in Ontario, and 1 in New Brunswick. The building plants are in Nova Scotia, Ontario, and Manitoba, and the projected plants are in Ontario.

PRODUCTION OF IRON ORE AND COAL IN CANADA.

It is officially stated that the production of iron ore in Canada in 1904 amounted to 312,286 long tons, against 235,977 tons in 1903, and that the production of coal in Canada in 1904 amounted to 6,705,232 long tons, against 6,824,999 tons in 1903. The figures for 1904 are subject to revision.

STATISTICS OF THE EUROPEAN IRON TRADE FOR 1904.

GREAT BRITAIN.

Mr. Jeans, the secretary of the British Iron Trade Association, has published the statistics of the production of pig iron, Bessemer steel, and open-hearth steel in Great Britain in 1904. from which the following summary is compiled:

Pig iron.—The total production of pig iron in 1904 amounted to 8,562,658 long tons, against 8,811,204 tons in 1903, 8,517,693 tons in 1902, and 7,851,830 tons in 1901. The decrease in 1904 as compared with 1903 was 248,546 tons. The production of iron ore in 1904 amounted to 13,774,282 tons, as compared with 13,715,645 tons in 1903. Great Britain is a large importer of iron ore for use in its blast furnaces. The imports of iron ore in 1904 amounted to 6,100,556 tons, against 6,314,162 tons in 1903, of which there were imported from Spain 4,648,335 tons in 1904 and 4,945,086 tons in 1903. The official Government statistics for 1904 may vary from those here given. The pig-iron statistics given by Mr. Jeans for previous years also vary from the Government statistics.

Bessemer steel.—The total production of Bessemer steel ingots in 1904 amounted to 1,781,533 long tons, against 1,910,018 tons in 1903, 1,825,779 tons in 1902, and 1,606,253 tons in 1901. The decrease in 1904 as compared with 1903 was 128,485 tons. Of the total production in 1904 there were produced by the acid process 1,129,224 tons and by the basic process 652,309 tons. Nearly one-half (304,817 tons) of the basic Bessemer production of 1904 was produced in the Cleveland district. In this district the production of acid Bessemer steel has been gradually declining in recent years, until in 1904 it fell to 10,449 tons.

Open-hearth steel.—The total production of open-hearth steel ingots in 1904 amounted to 3,245,346 long tons, against 3,124,083 tons in 1903, 3,083,288 tons in 1902, and 3,290,791 tons in 1901. The increased production in 1904 as compared with 1903 was 121,263 tons. Of the total production last year 662,064 tons were basic steel and 2,583,282 tons were acid steel. Since 1901 the production of basic open-hearth steel in Great Britain has almost doubled. It will be observed, however, that the aggregate production of open-hearth steel in Great Britain has made no progress in the last four years, the output in 1904 being a little less than in 1901.

The production in Great Britain of direct steel castings by the Bessemer and open-hearth processes is never given in British statistics, nor is the production of crucible steel ingots and castings. The American Iron and Steel Association has estimated the annual production of crucible steel in Great Britain in recent years as amounting to 100,000 tons.

Coal.—Complete statistics of the production of coal in Great Britain in 1904 have been published by the mining statistics branch of the Home Department of His Majesty's Government. The production in 1904 was 232,428,272 tons, against 230,334,469 tons in 1903.

GERMANY.

The Imperial Statistical Bureau of Germany publishes the following statistics of the production of coal and lignite and iron ore in the German Empire, including Luxemburg, in 1904, compared with the production in 1903:

Coal and lignite.—The production of coal in Germany in 1904 was 120,815,503 metric tons, against 116,637,765 tons in 1903. The production of lignite in 1904 was 48,632,769 tons, against 45,819,488 tons in 1903. The total production of coal and lignite in 1904 was 169,448,272 tons, against 162,457,253 tons in 1903. The production of coal and lignite in 1904 was 6,991,019 tons greater than in 1903.

Iron ore.—The production of iron ore in Germany in 1904 was 22,047,297 metric tons, against 21,230,650 tons in 1903—an increase in 1904 of 816,647 tons.

Pig iron.—Doctor Leidig, chief of the statistical bureau of the Verein Deutscher Eisen und Stahl Industrieller, gives the production of pig iron in Germany and Luxemburg in 1904 as provisionally amounting to 10,103,941 metric tons, against 10,085,634 tons in 1903—an increase of 18,307 tons.

Steel.—Doctor Leidig also gives the production of Bessemer and open-hearth steel ingots and castings in Germany and Luxemburg as amounting in 1904 to 8,930,291 metric tons, against 8,801,515 tons in 1903. Of the production in 1904, 5,949,171 tons were Bessemer ingots, of which 423,742 tons were made by the acid process and 5,525,429 tons by the basic process, and 2,828,306 tons were open-hearth ingots, of which 130,546 tons were made by the acid process and 2,697,760 tons by the basic process. The total production of direct steel castings in 1904 amounted to 152,814 tons, of which 56,409 tons were made by the acid process and 96,405 tons by the basic process. Doctor Leidig does not separate Bessemer from open-hearth castings.

FRANCE.

The Journal Officiel gives the following provisional statistics of the production of iron and steel in France in 1904, compared with definite statistics for 1903:

Pig iron.—The production of pig iron in France in 1904 amounted to 2,999,787 metric tons, against 2,840,517 tons in 1903, an increase of 159,270 tons.

Steel.—The production of Bessemer and open-hearth steel ingots in France in 1904 was as follows, in metric tons: Bessemer steel, 1,334,798 tons; open-hearth steel, 745,756 tons; total, 2,080,554 tons, against 1,161,954 tons of Bessemer steel and 677,674 tons of open-hearth steel in 1903, making a total of 1,839,628 tons in that year. The production of steel by various minor processes in 1904 amounted to 26,785 metric tons, against 23,058 tons in 1903. The total production of steel in the above forms in 1904 was 2,107,339 tons, against a total production in 1903 of 1,862,686 tons. In the foregoing statistics steel castings are not included. In 1903 they amounted to about 23,000 tons.

BELGIUM.

Pig iron.—The production of pig iron in Belgium in 1904 is reported to have amounted to 1,307,399 metric tons, against 1,216,500 tons in 1903, an increase of 90,899 tons.

Steel.—The production of Bessemer and open-hearth steel ingots in Belgium in 1904 is reported to have amounted to 1,083,000 metric tons, against 969,230 tons in 1903, an increase of 113,770 tons.

THE WORLD'S IRON TRADE IN 1903.

THE WORLD'S PRODUCTION OF IRON ORE AND COAL.

In the following table are given revised statistics of the production of iron ore and coal in all countries in 1903, except in a few instances, when figures for 1902 and 1901 are given. English tons of 2,240 pounds are used in giving the production of the United States, Great Britain, Canada, Cuba, India, Natal, Transvaal, New South Wales, New Zealand, other Australasia, and "other countries," and metric tons of 2,204 pounds are used for all other countries named in the table, the latter being used as the equivalent of English tons in ascertaining the total production of all countries. The Belgian coal statistics do not include lignite.

World's production of iron ore and coal and lignite in 1903, by countries.

Country.	Iron ore.			Coal and lignite.		
	Year.	Quantity.	Percentage.	Year.	Quantity.	Percentage.
		Tons.			*Tons.*	
United States	1903	35,019,308	34.41	1903	319,068,229	36.53
Great Britain	1903	13,715,645	13.48	1903	230,334,469	26.37
Germany and Luxemburg	1903	21,230,650	20.86	1903	162,457,253	18.60
France	1903	6,219,541	6.11	1903	34,906,418	4.00
Belgium	1903	184,400	.18	1903	[a] 23,796,680	2.72
Austria-Hungary [b]	1903	3,269,175	3.21	1903	40,628,785	4.65
Russia and Finland	1902	5,648,227	5.55	1903	17,500,000	2.00
Sweden	1903	3,677,841	3.61	1903	320,390	.04
Spain	1903	8,304,153	8.16	1903	2,587,652	.30
Italy	1903	374,790	.37	1903	346,887	.04
Dominion of Canada	1903	235,977	.23	1903	6,824,999	.78
Cuba	1903	624,858	.61			
Transvaal				1903	2,258,284	.26
Natal				1903	713,548	.08
India	1902	85,235	.08	1903	7,438,386	.85
Greece	1903	360,310	.35	1903	10,700	.00
New South Wales	1902	13,555	.01	1903	6,354,846	.73
New Zealand				1903	1,420,229	.16
Other Australasia	1902	116,994	.12	1903	626,731	.07
Japan	1901	70,172	.07	1902	9,701,682	1.11
Algeria	1903	588,893	.58	1903	140	.00
Other countries (about)	1903	2,045,276	2.01	1903	6,238,692	.71
Total		101,785,000	100.00		873,535,000	100.00

[a] Lignite not included. [b] Includes Bosnia and Herzegovina.

The iron-ore figures for "other countries" include 728,721 long tons which were mined by Newfoundland in 1902.

THE WORLD'S PRODUCTION OF PIG IRON AND STEEL.

In the following table are given revised statistics of the production of pig iron and steel in all countries in 1903. English tons of 2,240 pounds are used for the United States, Great Britain, Canada, and "other countries," and metric tons of 2,204 pounds for all other countries, metric tons being used as the equivalent of English tons in ascertaining the total production for all countries. The statistics of steel production for the United States, Great Britain, Germany and Luxemburg, France, Belgium, Austria-Hungary, Russia and Finland, Sweden, Spain, Italy, and Canada embrace ingots and in some cases direct castings.

World's production of pig iron and steel in 1903, by countries.

Country.	Pig iron.			Steel.		
	Year.	Quantity.	Percentage.	Year.	Quantity.	Percentage.
		Tons.			*Tons.*	
United States	1903	18,009,252	38.84	1903	14,534,978	40.55
Great Britain	1903	8,935,063	19.27	1903	[a] 5,134,101	14.32
Germany and Luxemburg	1903	10,085,634	21.75	1903	8,801,516	24.55
France	1903	2,840,517	6.13	1903	1,885,000	5.26
Belgium	1903	1,216,500	2.63	1903	969,230	2.70
Austria-Hungary [b]	1903	1,428,158	3.08	1902	[c] 1,193,000	3.33
Russia and Finland	1903	2,453,953	5.29	1903	2,374,650	6.63
Sweden	1903	506,826	1.09	1903	318,897	.89
Spain	1903	302,657	.65	1903	199,642	.56
Italy	1903	[d] 75,279	.16	1903	187,361	.52
Dominion of Canada	1903	265,418	.57	1903	181,514	.51
Other countries (about)	1903	248,744	.54	1903	66,112	.18
Total	....	46,368,000	100.00	....	35,846,000	100.00

[a] Does not include direct steel castings.
[b] Includes Bosnia and Herzegovina.
[c] Estimated. Official figures wanting.
[d] Not including blast-furnace castings.

In tables that have appeared in previous issues of this report the world's probable total production of pig iron has been given as 825,000 long tons in 1800; as 1,825,000 tons in 1830; as 4,750,000 tons in 1850; as 11,900,000 tons in 1870; as 17,950,000 tons in 1880; as 27,157,000 tons in 1890; as 40,400,000 tons in 1900; and now it is estimated as 46,368,000 tons for 1903, the United States contributing nearly 39 per cent.

The world's production of steel was estimated as amounting to 3,021,000 long tons in 1878. The production of 1889 was estimated as amounting to 10,948,000 tons. The figures given in the preceding table show that the world's production of steel had increased in 1903 to 35,846,000 tons, of which the United States contributed over 40 per cent.

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